Sheet Metal Industries

The only Journal in the World wholly devoted to the Manufacture, Manipulation, Fabrication, Welding, Assembly and Finishing of Ferrous and Non-Ferrous Sheet and Strip

VOL. 37 : No. 397 MAY 1960 PRICE 2/6


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Built by
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help to produce High Quality Domestic Appliances
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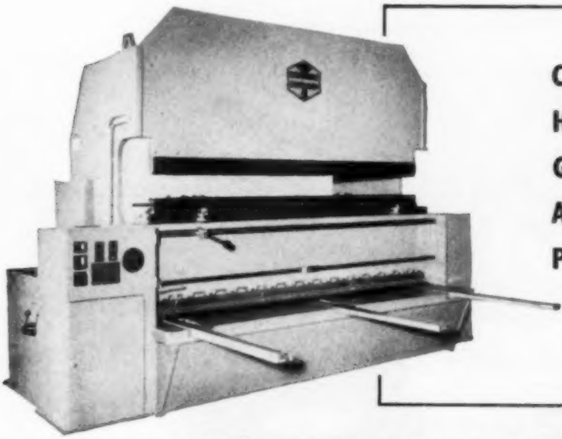

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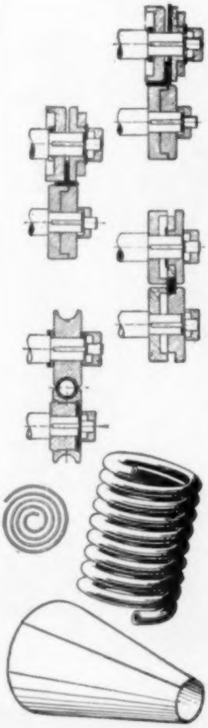
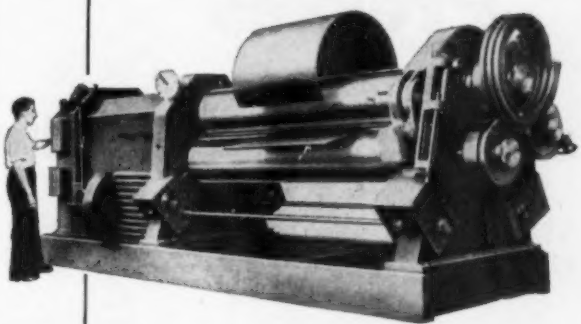


COMBINED PLATE AND SECTION BENDING ROLL OF INITIAL PINCH TYPE



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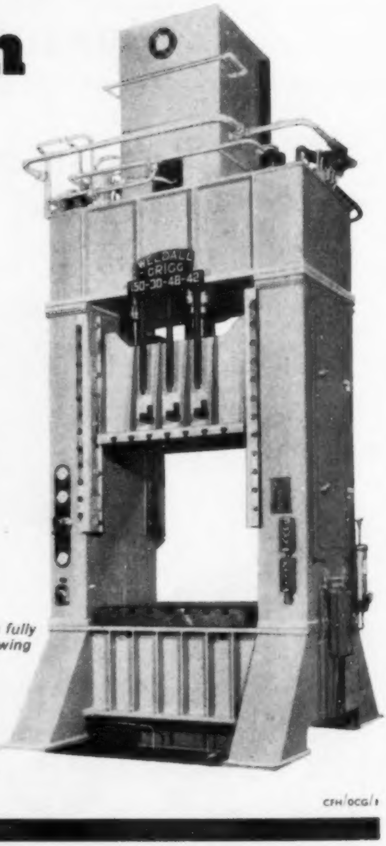

Illustrated is a 150 ton fully automatic Deep Drawing Hydraulic Press

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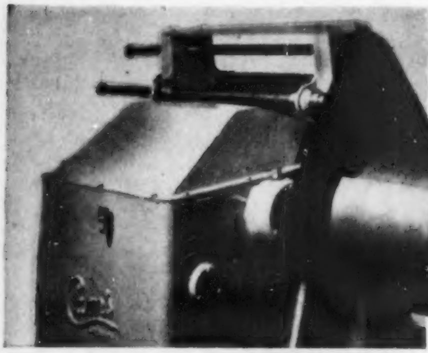

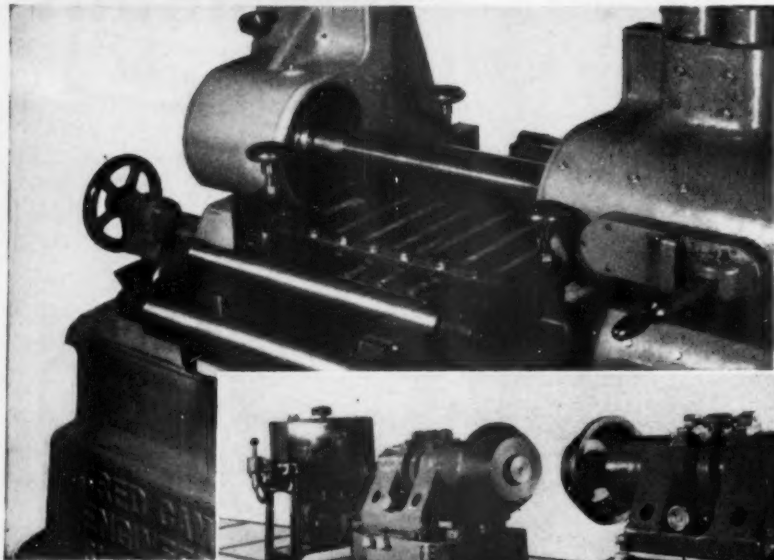

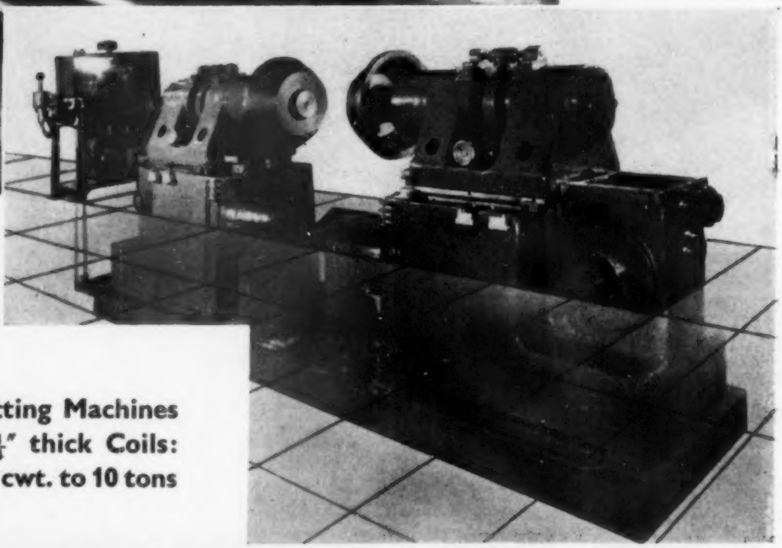

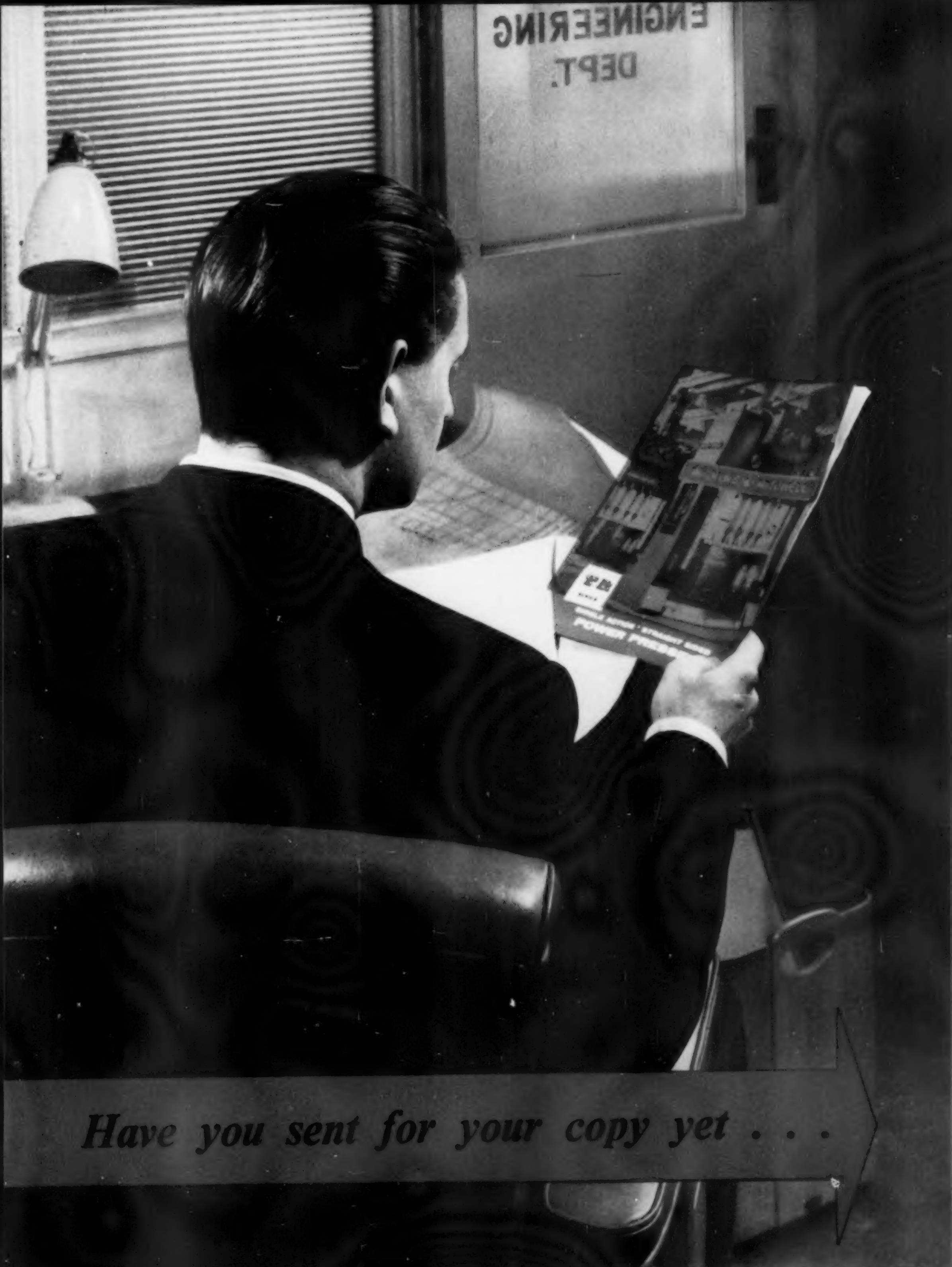
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June 25—July 8

(Sundays excepted)

9.30 am—6 pm

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Engineers' Small Tools
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Here's your opportunity to see them all under a single roof—to see many of them powered and in operation—to discuss their application to your own production problems with the world's best-informed production experts.

International Machine Tool Exhibition 1960

Organized by
The Machine Tool
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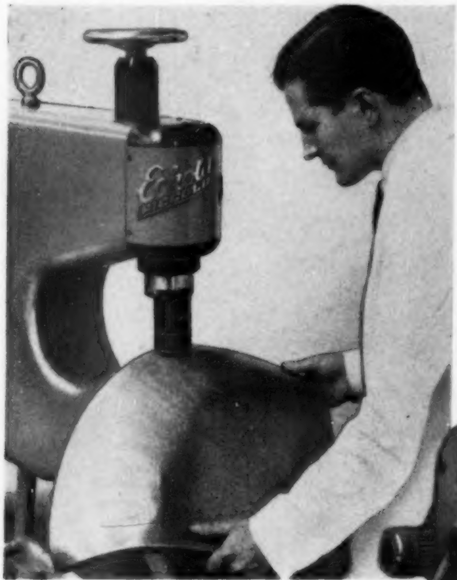

British Federal

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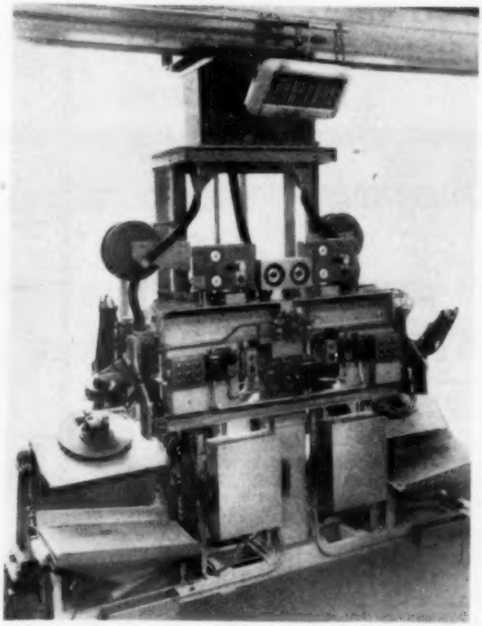
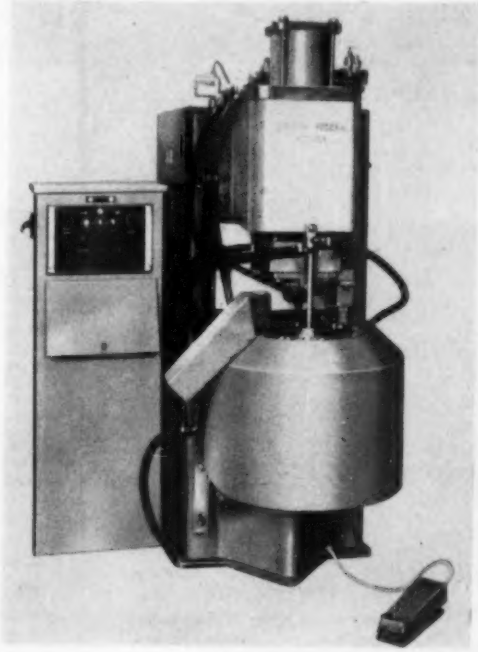


Specially designed twin head Submerged Arc Welding Machine with flux reclamation unit designed for welding covers to rear axle banjo sections.



Heavy duty 500 KVA projection Welding Machine fitted with rotary indexing tooling incorporating automatic ejection. Operating speeds up to approximately forty strokes per minute, available also with hopper feed.

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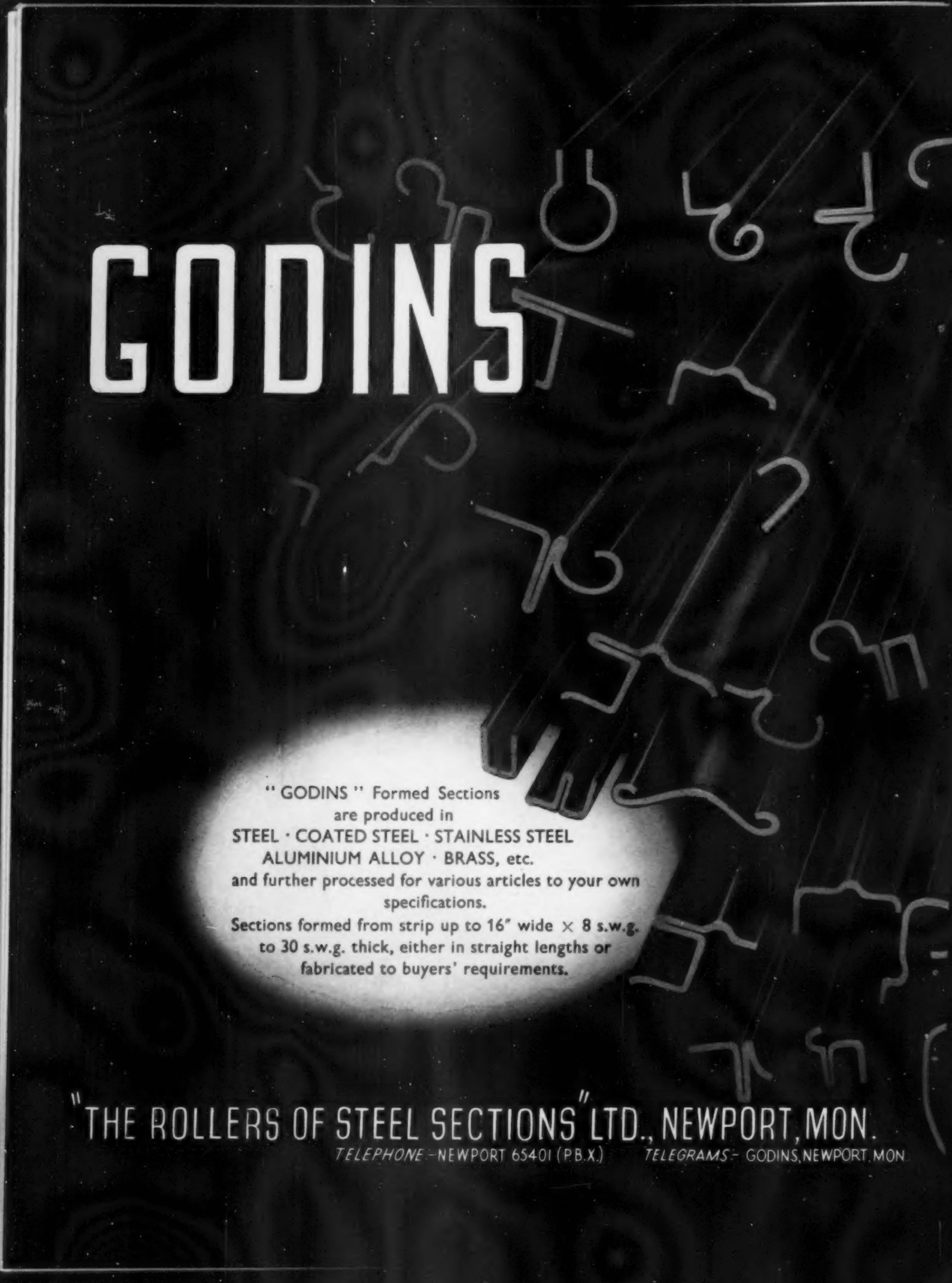
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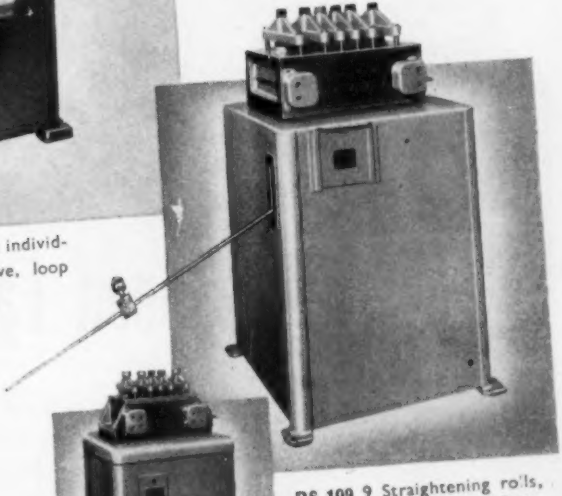

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5 Models available

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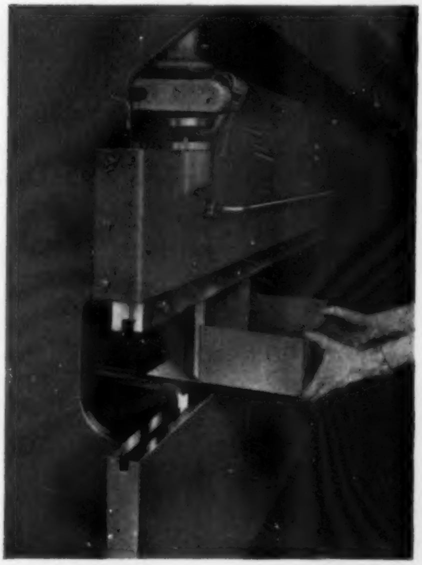

Illustration shows No. 56 Press Brake with Box and Pan Dies

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Capacity 30 tons. Handles 6 ft. × 14 g. Constant speed, 34 strokes per minute.

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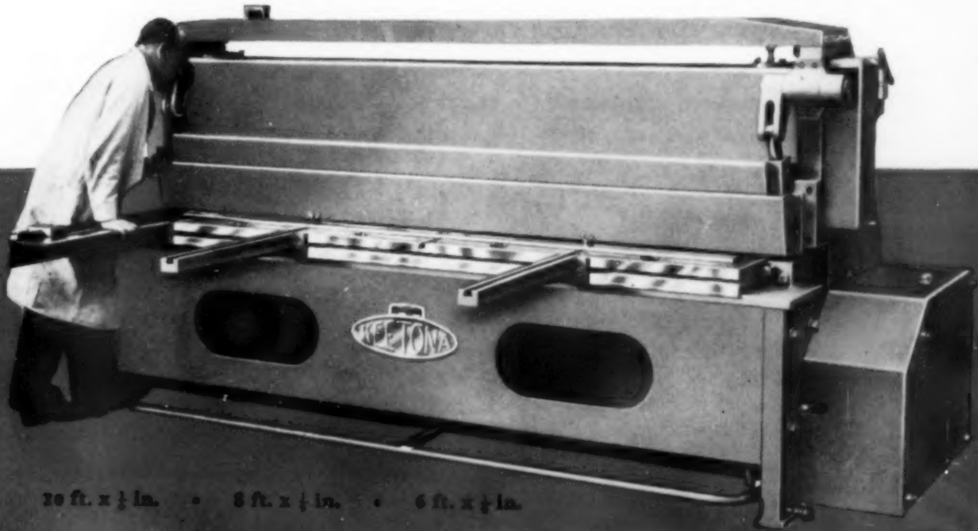

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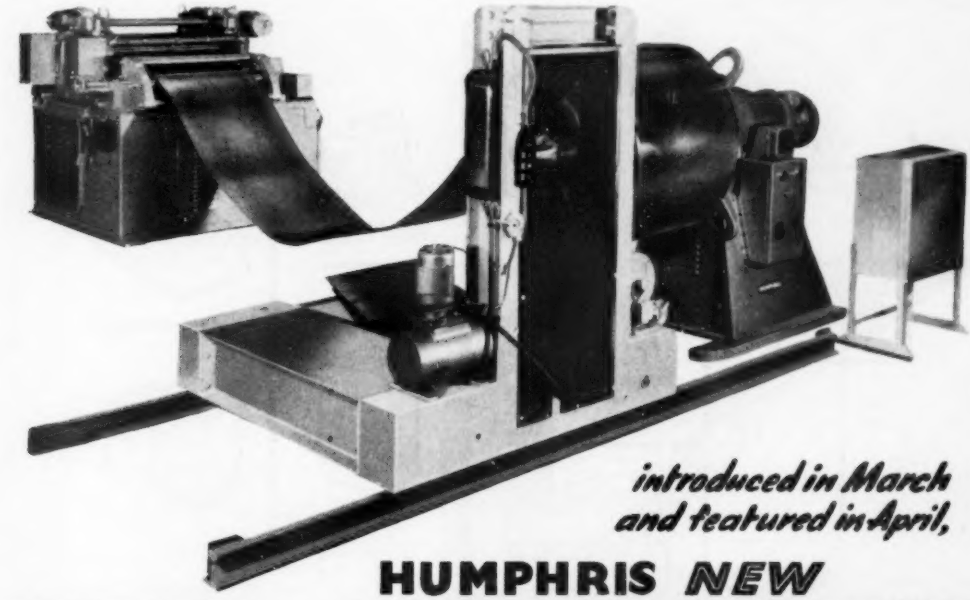

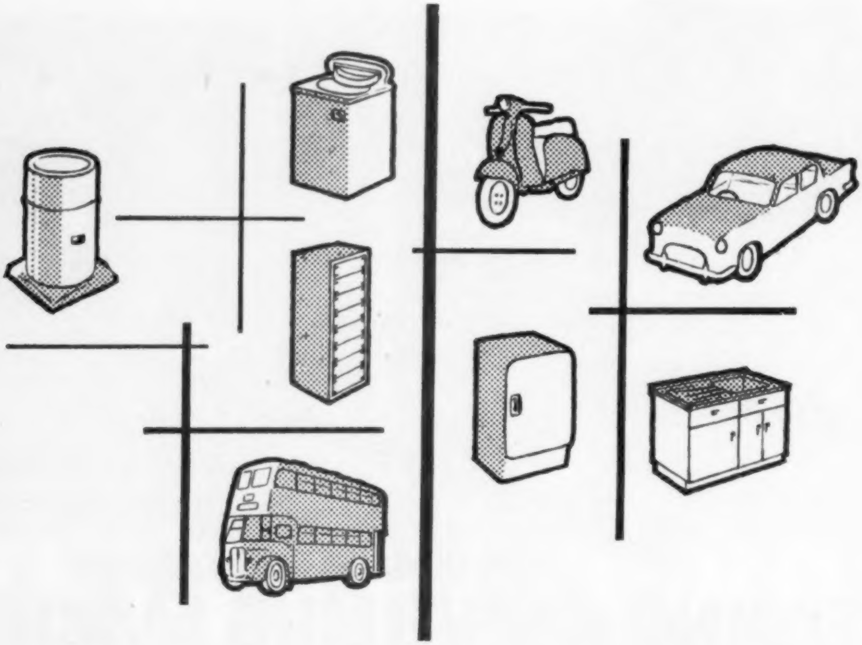

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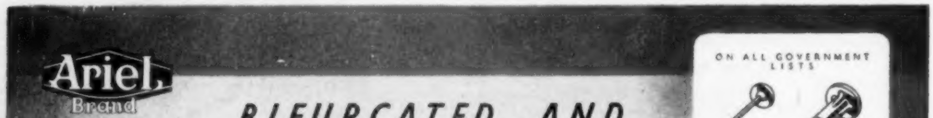

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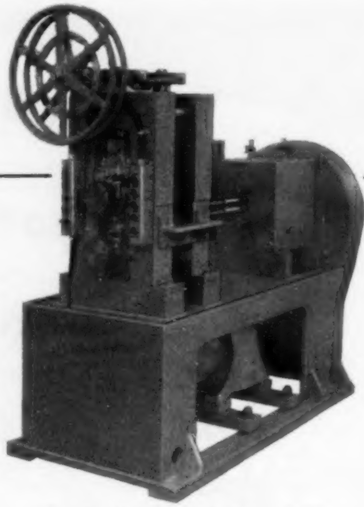

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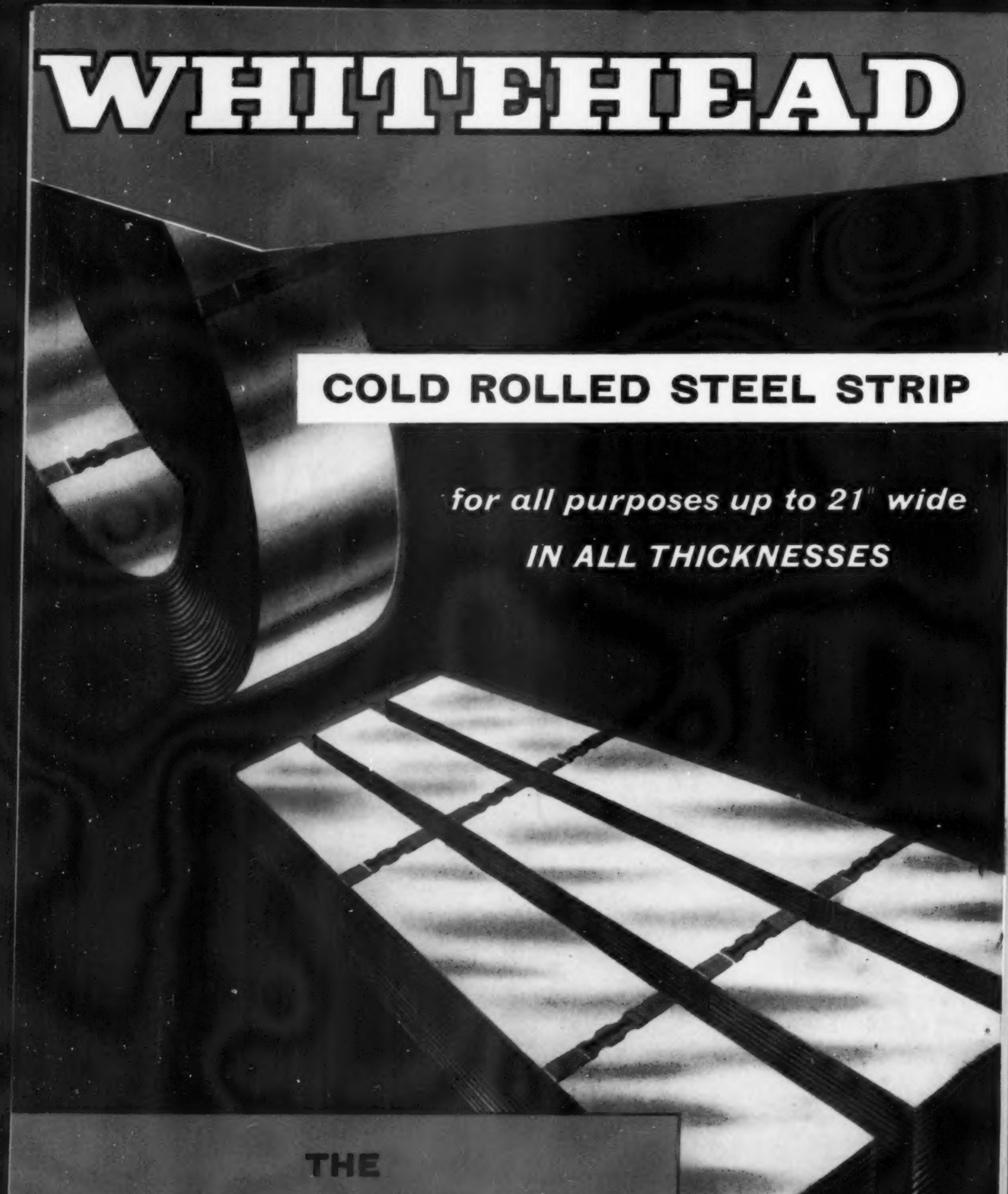

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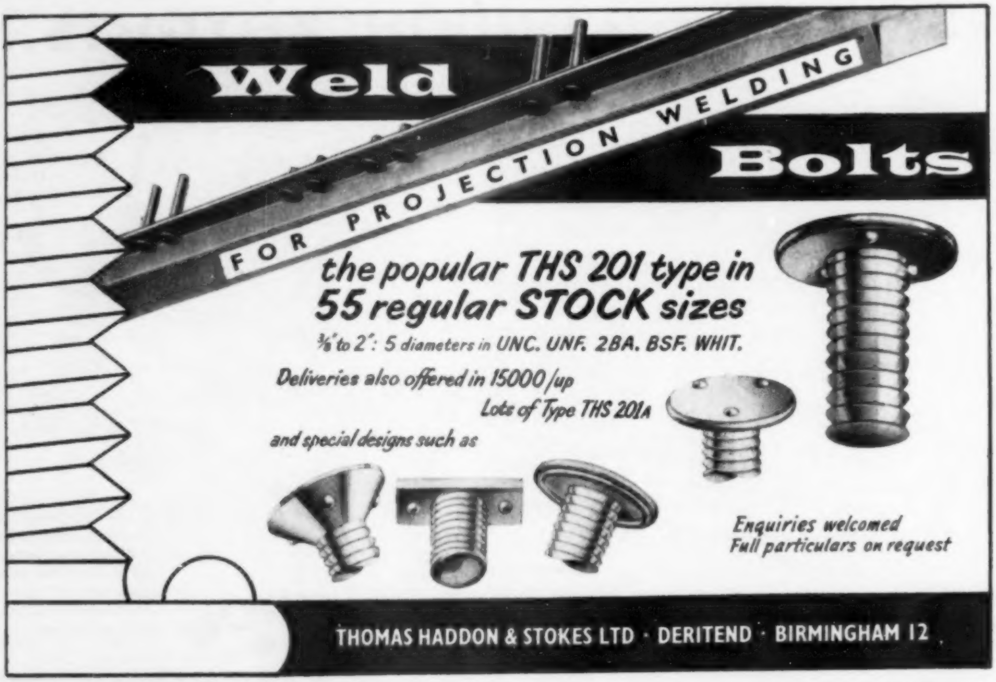
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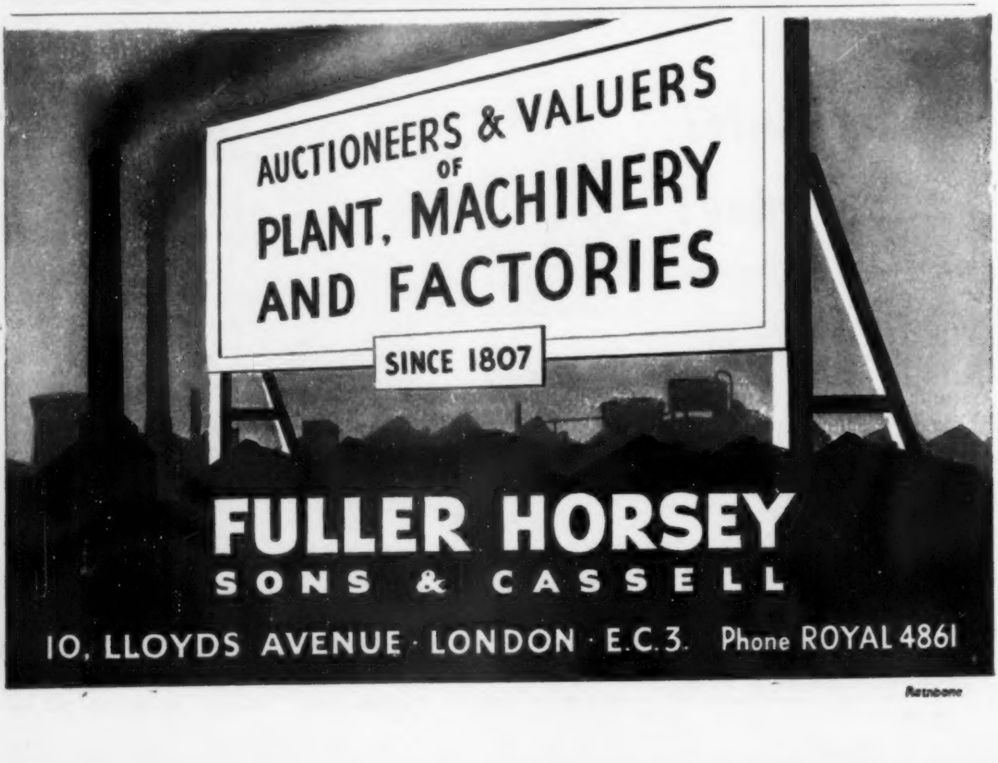
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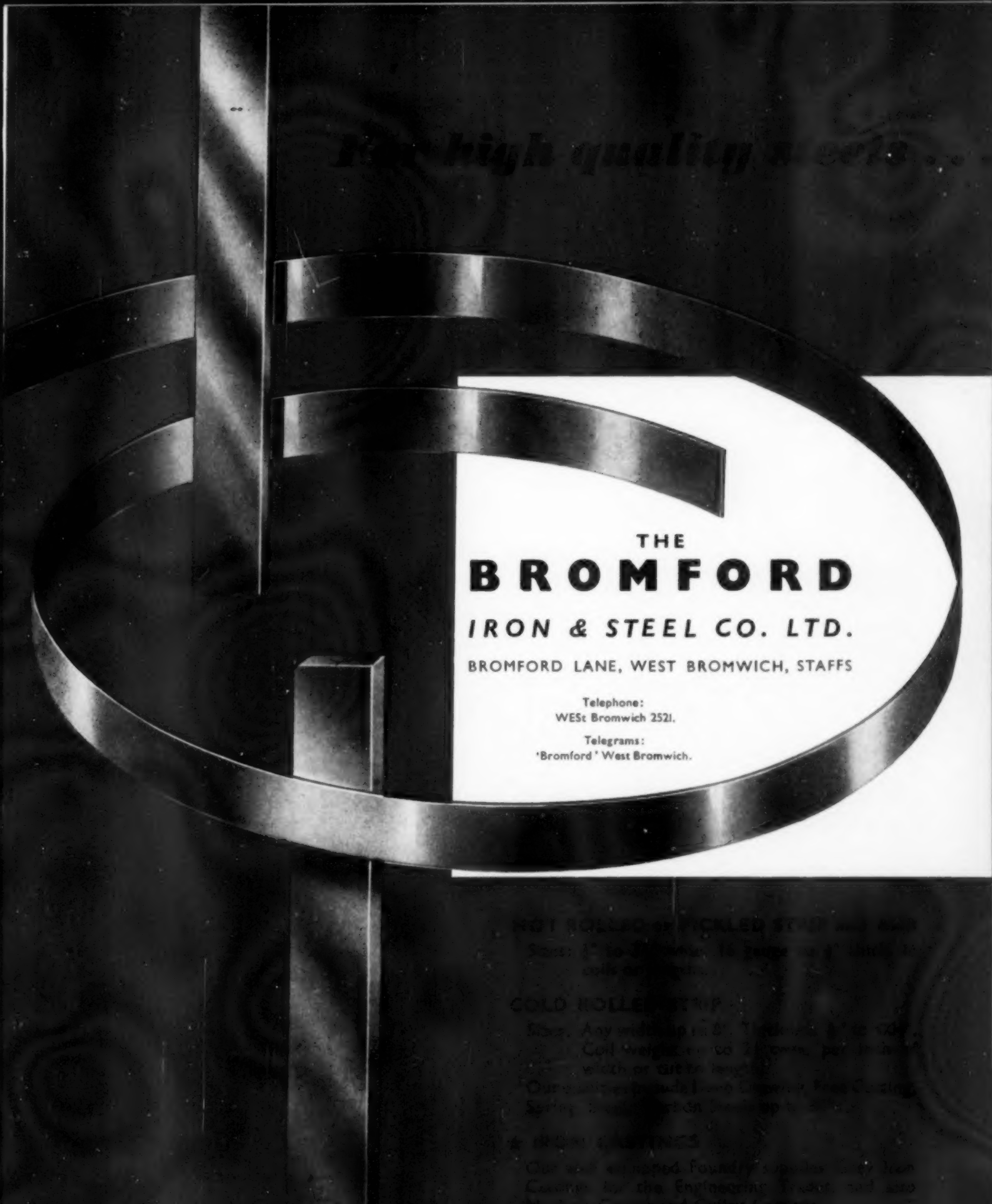
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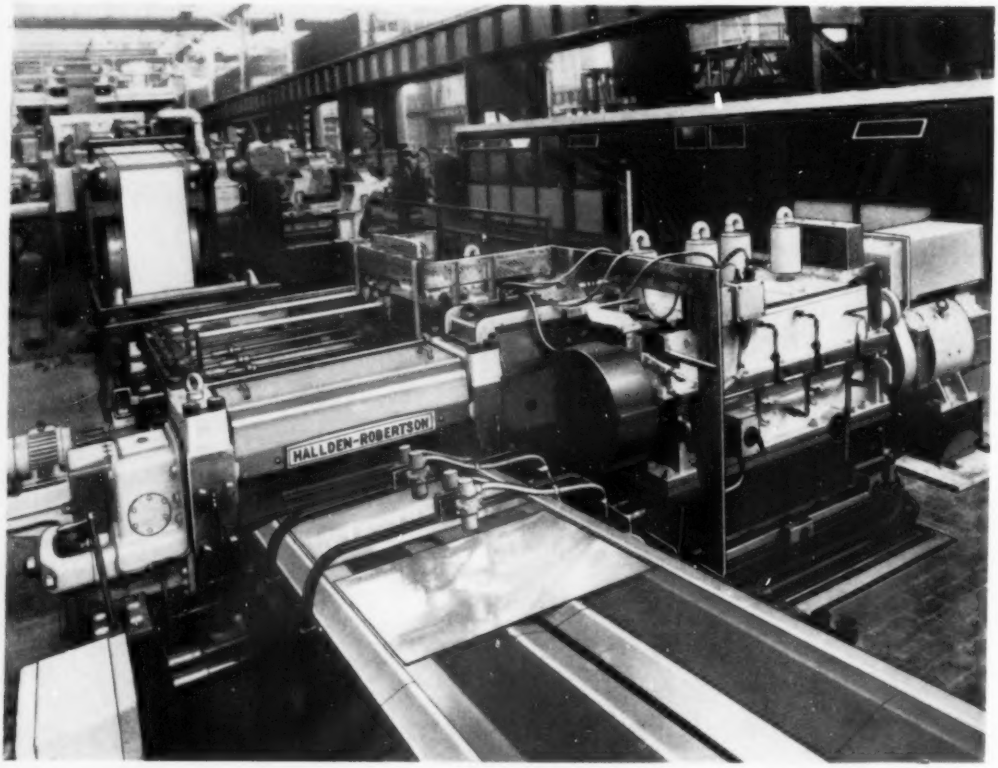

Photograph by courtesy of The Steel Company of Wales Ltd.

The illustration shows the machine in one of the Wean Tinning Lines. The three Cut-up Lines also include the same size machine which is capable of dealing with all tin-plate gauges and sheet sizes up to a rate of 428 sheets per minute.

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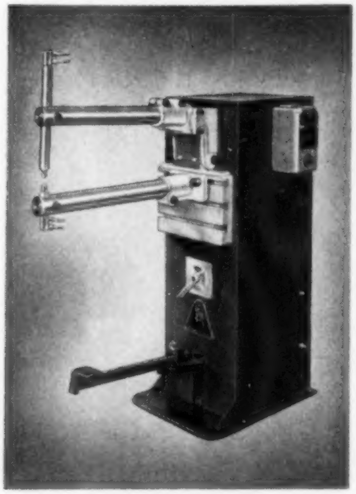

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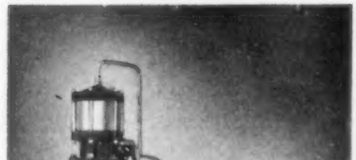

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Manufacturers of all types of Welding Machines including: Foot and Air Operated Pivot Type Spot Welders. Vertical Sliding Head Spot and Projection Welders with full electronic control. Seam Welders. Flash Butt Welders. Rivet Heaters. Auto Wire Butt Welders. Vertical Sliding Head Electric Resistance Hot Closing Machines with full electronic control of pressure and current.

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Bottom left is shown an 80 K.V.A. combined Spot and Projection Welder. Other capacities available.

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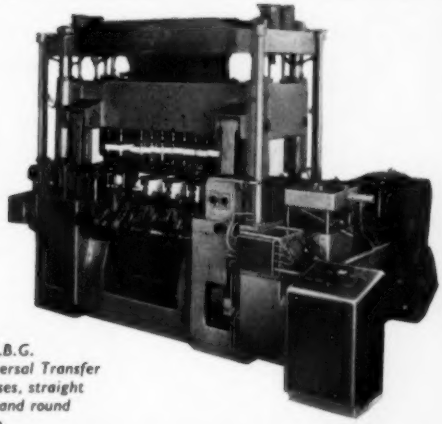

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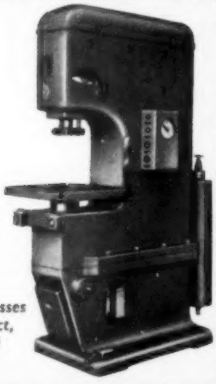

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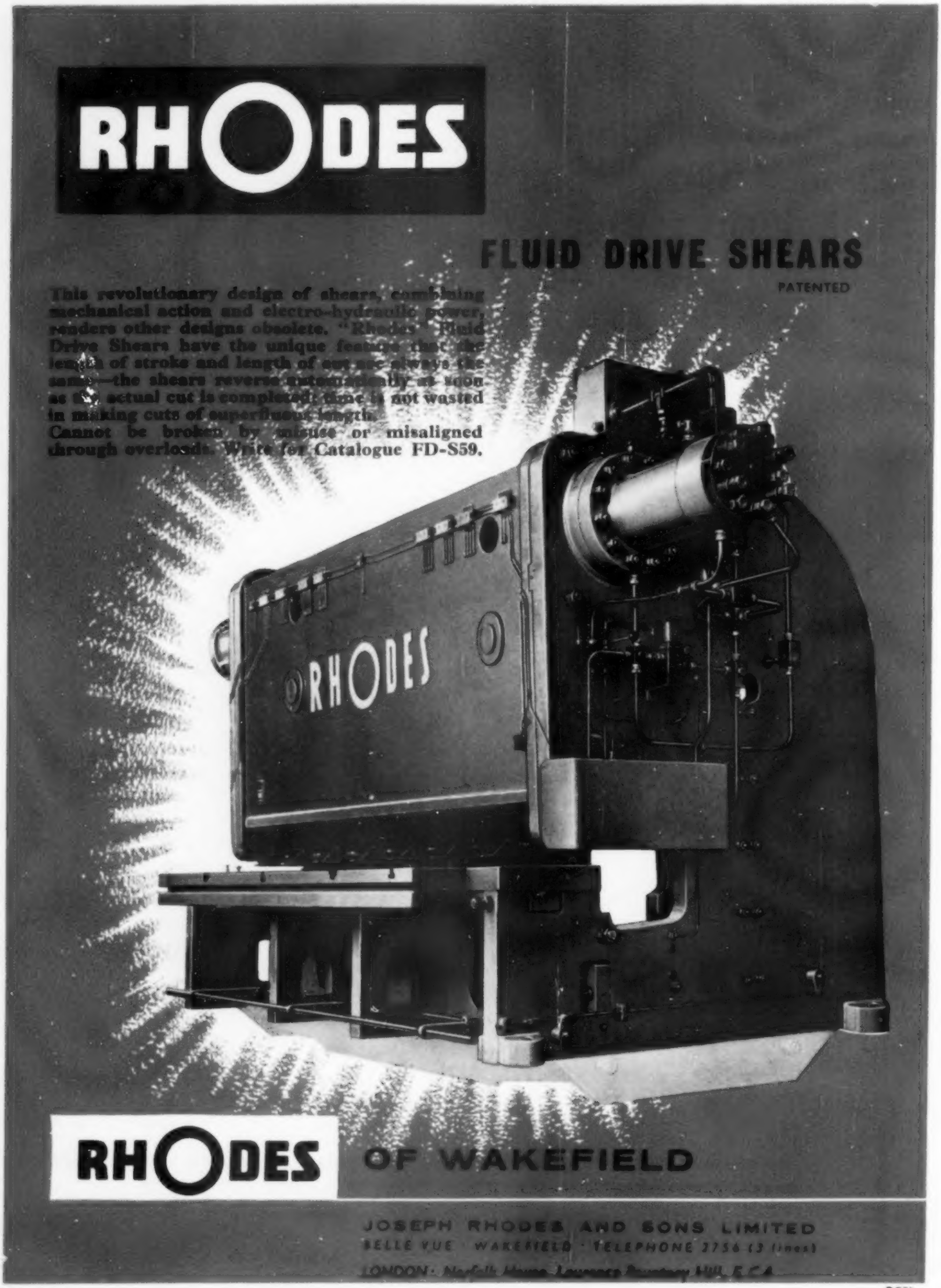
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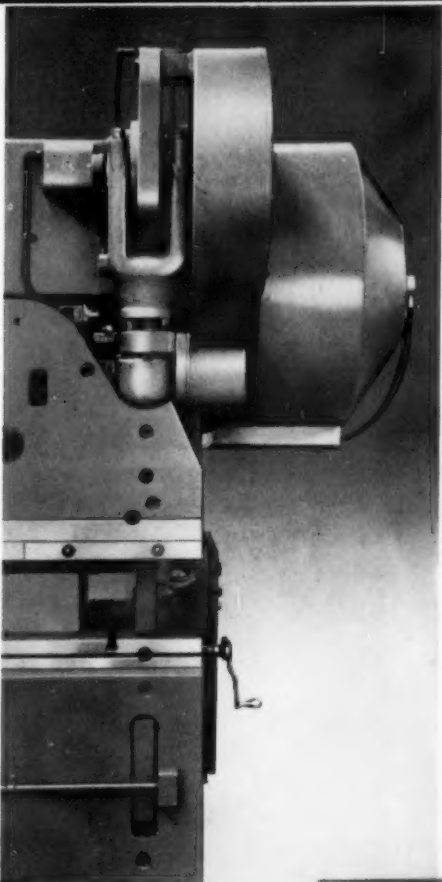

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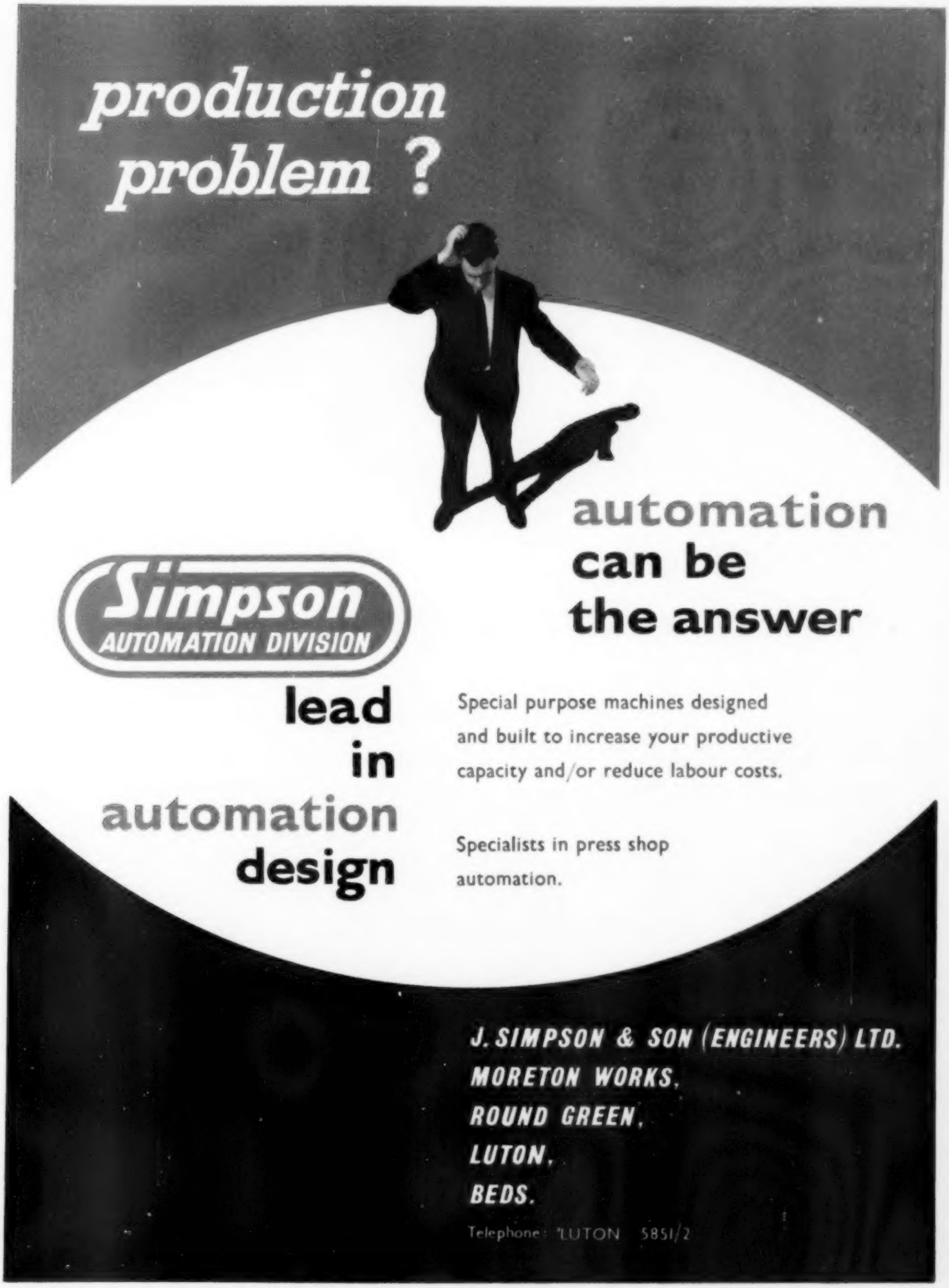
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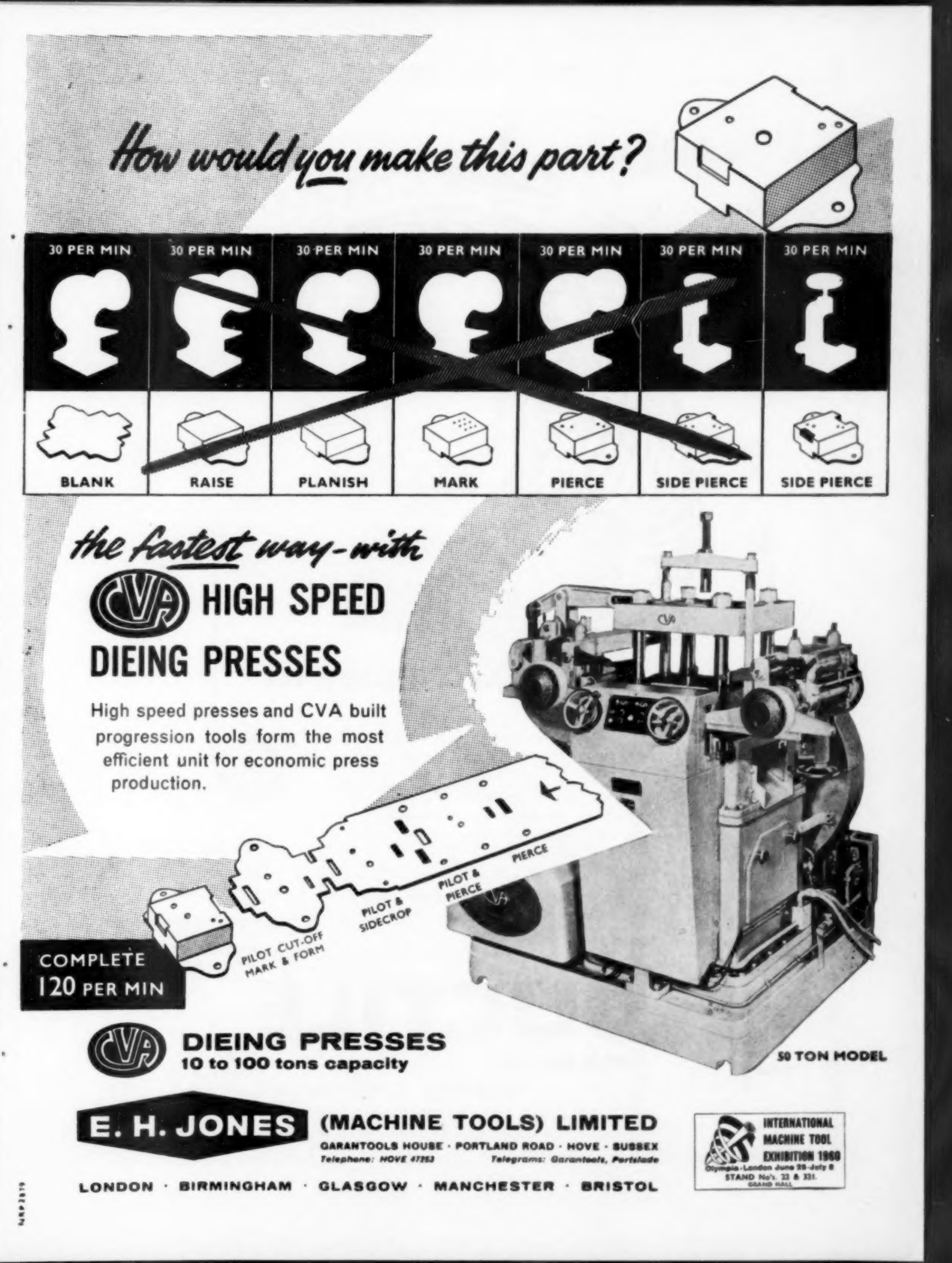

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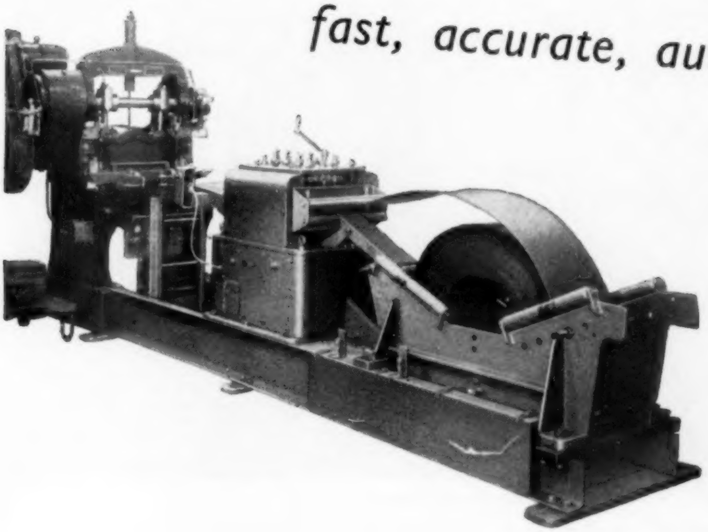

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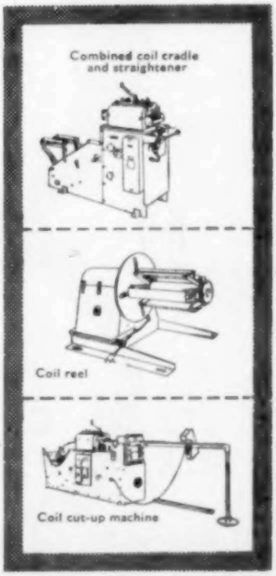

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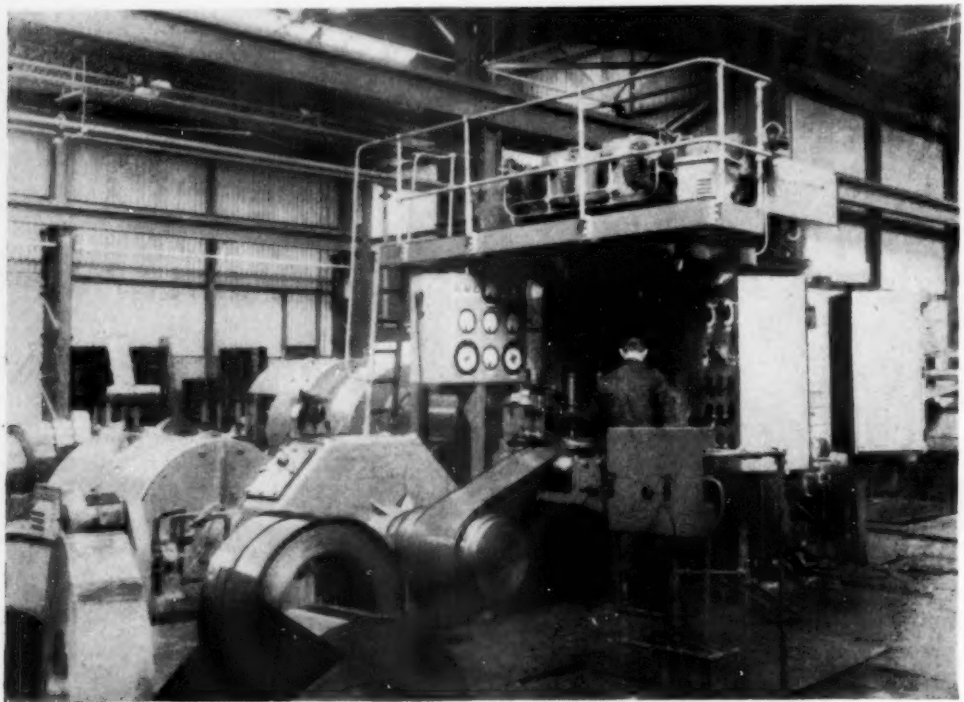

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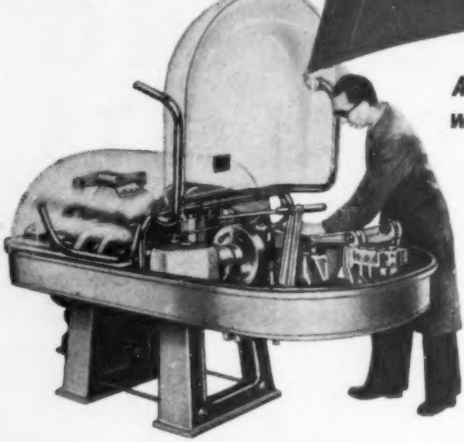

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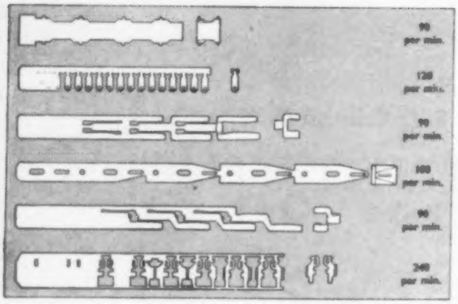

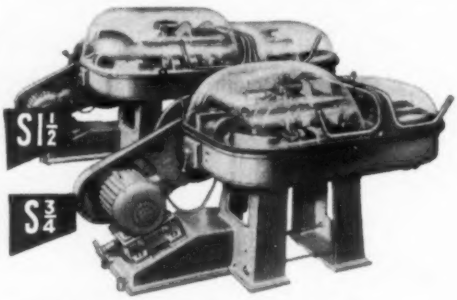

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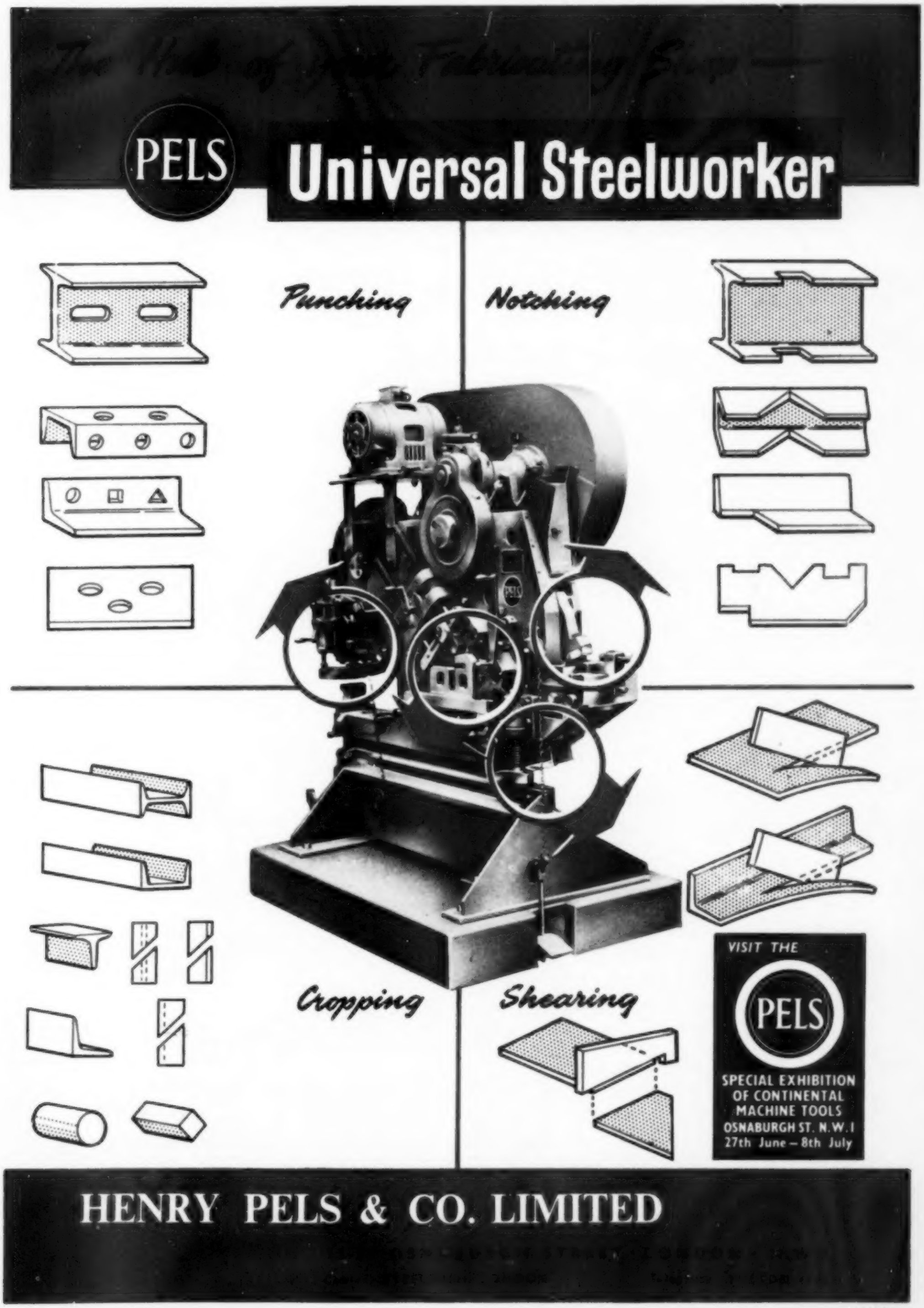

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MAY 1960
No. 397 Vol. 37

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Incorporating
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TRAINING THE TOOLMAKER

VERY soon, if all the present plans come to fruition, the countryside will be erupting in a new, but welcome, rash of motor-car works. Welcome they are because they indicate, with no small measure of certainty, the prosperity not only of the British car industry but also of the country as a whole. Even more welcome are they for the increased employment they will bring to certain areas which at the moment are in the course of transition from their more traditional basic industries.

Elsewhere in this issue we also report more extensions to stainless-steel production, and hardly a day goes by without some important announcement regarding future plans for providing increased output in other branches of the steel and non-ferrous metals industries.

Much of this increased production will be in the form of sheet and strip materials, a large proportion of which eventually will be formed to shape by pressworking. This will mean the production of more press tools and an increased demand for press-tool makers who have always been " key " men in industry.

The City and Guilds of London Institute started a scheme of examinations in press-tool making in 1955, but this has been poorly supported, even though it was well received in the first place. The examinations in machine-shop engineering, however, are all very well established and widely recognized in industry, but apparently many students describing themselves as tool-makers, and more specifically press-tool makers, elect to follow these examinations through to the final stage in preference to the more specialized examinations, and this has caused a small response to this scheme.

The Institute feels that in many centres of the manufacturing industries students must be available in numbers sufficient to justify the introduction of special courses and they would therefore welcome evidence of interest on the part of employers, which would encourage students who have passed the intermediate examination in machine-shop engineering either to take press-tool making as a specialist subject of the final course in machine-shop engineering *or* to take the special press-tool making course.

But is the reason for the poor support of the specialist courses wholly the fault of the employers? Is it not because today the production of a press tool is mainly a machining operation as a result of which the special skills of the traditional toolmaker are rapidly disappearing and more and more is he becoming a machine operative?

The "pride in the job" attitude of mind is also on the decline, and the average man prefers a general course from which he can obtain knowledge wide enough to allow him to change from one type of occupation to another.

Finally, we must not forget that the intake of apprentices is carefully controlled, and this may also be a further contributory factor in the relatively small number of students reporting for the specialist courses.

To give possible reasons for the failure of these courses to date is perhaps easy. We feel that they should be supported, and it is hoped that some rethinking on the part of all those concerned will ensure that at least a reasonable retention in industry of specialized skills will be made possible.

INSTITUTE OF SHEET METAL ENGINEERING • *Recent and Forthcoming Activities*

ANNUAL GENERAL MEETING AND LUNCHEON

THE Fifteenth Annual General Meeting of the Institute will be held at the Café Royal, Regent Street, London, W.1, at 12 noon on Wednesday, May 4, 1960. The Agenda for this meeting has been circulated to all members.

The meeting will be followed at 12.30 for 1 p.m. by an Institute Luncheon at which the principal guest of the Institute will be Sir William Robson-Brown, Member of Parliament for Esher.

WORKS TOUR IN SOUTH WALES

The tour of works which has been a biennial feature of the Institute's programme since 1948, will this year be staged in South Wales. The tour will start in the Cardiff area on October 3, proceeding to the Swansea area for the next two days and concluding with visits to works in the Merthyr Tydfil area for the last two days of the week.

Companies who have extended invitations to the Institute to include their works in the tour are as follows: Guest Keen and Nettlefolds (South Wales) Ltd., Cardiff; Simmonds Aerocessories Ltd., Treforest; British Iron and Steel Research Association Laboratories, Sketty Hall; Aluminium Wire and Cable Co. Ltd., Port Tennant; Morris Motors Ltd., Llanelly; The Steel Company of Wales Ltd., Tinplate Division, Velindre; The Anglo-Celtic Watch Co. Ltd., Ystradgynlais; Hoover (Washing Machines) Ltd., Merthyr Tydfil; Lines Bros. Ltd., Merthyr Tydfil; Pilkington Brothers Ltd., Pontypool.

BRITISH DEEP DRAWING RESEARCH GROUP

At the Annual Meeting of the British Deep Drawing Research Group Committee held on March 29, Dr. J. G. Wistreich was elected Chairman for the ensuing year in succession to Mr. G. Murray, whose recent illness had compelled him to withdraw his name from consideration for re-election to that office. Mr. J. A. Grainger was elected Vice-Chairman.

Members of the Group will be attending the Colloquium on " Sheet Metal Forming with Special Emphasis on Methods of Testing " being organized jointly by the International Deep Drawing Research Group and the Société Française de Métallurgie in Paris on May 23 to 25, 1960. At the meeting of the I.D.D.R.G. in Paris following the Colloquium, the British Group will be represented by Dr. J. G. Wistreich (Group Chairman), Mr. John Hooper (Hon. Group Secretary) and Dr. J. Wallace (Sheffield University).

One of the items to be discussed at the I.D.D.R.G. meeting is the possibility of extending international collaboration in research and investigation into problems of deep drawing and allied subjects.

MIDLAND BRANCH ANNUAL GENERAL MEETING AND FILM SHOW

The Eighth Annual General Meeting of the Midland Branch of the Institute was held in the new College of Technology, Gosta Green, Birmingham, on Wednesday, March 9, with Mr. T. W. Elkington, Branch Chairman, presiding. The four retiring members of the Committee were re-elected for a further term and to fill a further vacancy, Mr. D. H. G. Abel, Northern Aluminium Co. Ltd., was elected to the Committee.

In making his annual report to the members, the Chairman expressed pleasure in the fact that the Branch had continued to enjoy widespread support from members. The Branch Dinner had proved a most enjoyable function, and applications for the works visit had been so numerous that it had to be staged in two separate parts. All the technical meetings had been well attended and in spite of some very bad weather, attendances had ranged between 110 and 300. This encouraged the Committee in their belief that they were providing the type of meeting which was of interest to the membership and every effort would be made to maintain this standard in the future. In view of the valuable work which the Institute and its increasing number of branches was carrying out, the Chairman looked forward to a considerable expansion in membership in the year ahead and concluded his report by expressing thanks to all those who gave so freely of their time and efforts in organizing the work of the Branch, and in particular to Mr. E. N. Salmon, the Hon. Branch Secretary.

Following the Annual General Meeting, those who were present, numbering about 220, enjoyed a film show.

INTERNATIONAL CONFERENCE ON COLD EXTRUSION OF STEEL

Plans are well advanced for the projected Conference on Cold Extrusion of Steel, which the Institute is proposing to hold in Sheffield on November 21-23 of this year. The programme at present includes some fifteen papers and one or more works visits. Details are expected to be finalized during the next few weeks when the draft programme will be published.

The Design and Use of COLD-FORGED COMPONENTS*

By H. D. FELDMANN†

THE demand for cold-forged (cold-extruded) components in the various industries has grown steadily during the past 10 years. In competition with almost any other process for the manufacture of steel components the cold forging process has firmly established its own market. The application of this technique will make further progress, but it is worth while to summarize the general principles that designers have to observe.

As there has been much published material during the recent years on the cold-forging process as well as on the application of cold-forged parts, this article will consider only the points of main interest to designers.

Economic Production

The cold-forging process lends itself economically to mass-produced components only. Experience has shown that depending on the component weight, the shape and the equipment available, the following minimum piece rates are needed to assure reasonable cost of production :—

Weight, approx.	Universal installation	Special installation
	Min. number of pieces	Min. number of pieces
0.035 to 0.70 oz.	10,000	500,000
0.70 to 17.5 oz.	5,000	200,000
17.5 oz. to 22 lb.	3,000	100,000
22 to 77 lb. . .	1,500 to 10,000 according to shape	50,000 according to shape

It is recommended that costs in each case should be checked as a particular shape, varying surface condition or the claim for especially narrow tolerances may bring about considerable deviations from the above-mentioned scheme.

It is necessary to ascertain whether a short- or a long-term requirement has to be satisfied and to check the demand per month or per year. When ordering, place an order as large as possible, as small orders will often meet a producer's refusal or at least will invite him to claim extra charges, as the ratio between productive hours and time lost for tool setting plays an important part in this process. Allow a reasonable tolerance for the numbers of pieces to be delivered.

Steels

The process limits the choice of steel which can be processed due to the tool steels, the available equipment and to the heat- and surface-treatment techniques, if production costs are to be kept in reasonable limits. Suitable steel qualities are listed in Tables I and II according to British Standards, and the corresponding French, German, and U.S. qualities are added. As in any other cold-working operation, cold forging causes hardening, *i.e.*, hardness, tensile strength and yield stress are increased, while elongation and reduction of area are decreased. Therefore, Tables I and II show the physical properties of the raw material in the annealed condition as well as the physical properties of the component after cold forging. Comparison of the figures shows that the yield stress increases by 100 per cent. Therefore, it is possible to process in many cases low-carbon steels instead of high-carbon steels or alloy-steels formerly used for these components which afterwards had to be case-hardened or hardened and subsequently tempered. Thus it is not only possible to effect economies by using cheaper steel but also by avoiding heat-treatment, be it case-hardening or hardening with subsequent tempering.

Thus when making the choice of the suitable material, in addition to remembering that cold forging hardens the material it is advisable to inform the manufacturer on the physical properties needed in the final shape of the cold-forged component. This is more helpful to the manufacturer than to specify the steel quality. (Indicate hardness, tensile strength, yield stress and elongation). If the component in its subsequent treatment has

* In this article the author refers to "cold forging," a process that in this country is more usually called "cold extrusion." "Cold extrusion" is the name adopted to describe the process by the Cold Extrusion Sub-Committee of the Institute of Sheet Metal Engineering.

† Technical Director, Cold Forging Ltd. (A member of the Camp Bird Industries Group).

TABLE I—*Carbon and Alloy Steels used in U.K.*

	British B.S.	Annealed: Yield stress min. tons per sq. in.	Annealed: Tensile strength tons per sq. in.	Annealed: Elongation min. per cent	Strain hardening by cold forging: Yield stress min. tons per sq. in.	Strain hardening by cold forging: Tensile strength tons per sq. in.	Strain hardening by cold forging: Elongation min. per cent
For usual shape	Armco Iron	6	17—19	45	19	25—32	13
	En. 2A, En. 2A/1	15.5	22—28	20	25	31—44	12
	En. 2E, En. 32A, En. 32B, En. 32C	17	20—34	20	29	38—48	8
For special shape	En. 2C, En. 2D, En. 3A, En. 3C	29	25—31	28	34	38—50	6
	En. 206, En. 207, En. 201 ..	19	25—31	18	31	38—44	8
	En. 352	21	26—32	15	31	41—47	8
	En. 353	22	27—34	12	32	42—50	6

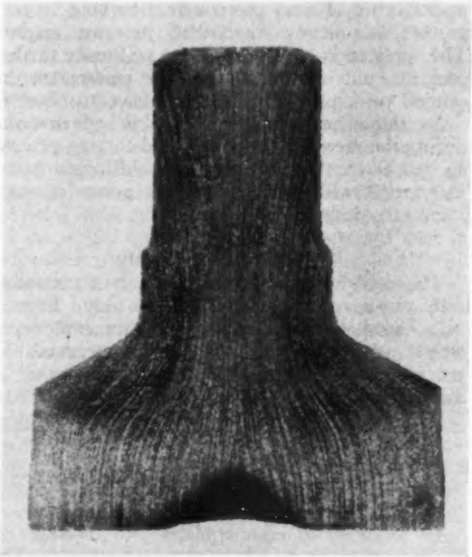
to be annealed then the hardening effect of the cold-forging process is lost and physical properties fall back to those indicated for raw material in Tables I and II.

Experience has shown that cold-forged parts compared with parts produced by other techniques have better fatigue strength and alternating stress values. This is due to the fact that the process permits the manufacture of shapes by cold working which previously were achieved by machining. Cold-forged parts show an uninterrupted grain flow and a perfect surface.

Thus, in cases where fatigue and good alternating stress values are of interest try to design the component so that it can be brought to final shape by cold forging only (Figs. 1 and 2).

Possible Shapes

Figs. 3 to 8 show that the main application of the process lies in the field of solid or hollow shapes symmetrical to the axis. In some cases also unsymmetrical shapes can be achieved. Theoretically dimensions are not limited by this technique. In practice, however, they are limited by the equip-



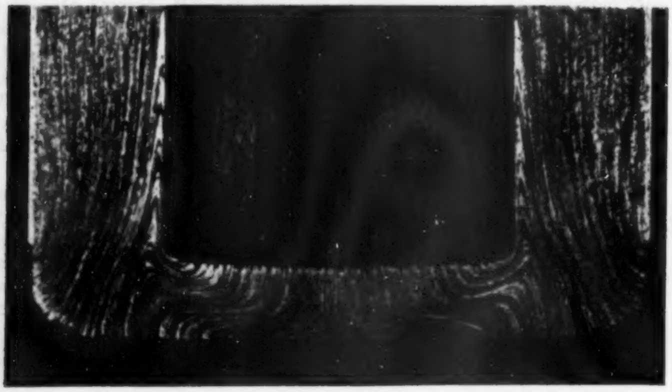


Fig. 1 (*above*).—*Cold-forged component showing how grain flow follows the shape of the component*

Fig. 2 (*left*).—*Cold-forged cup showing grain flow in bottom, axial to displacement of material*

TABLE II—*Steels used in Germany, France and U.S.A.*

	Deutschland nach DIN bzw. SEL	Annealed			Strain hardening by cold forging			French NF AFNOR	U.S.A. A.I.S.I. A.S.T.M.
		Yield stress min. kg./mm²	Tensile strength kg./mm²	Elongation min. per cent	Yield stress min. kg./mm²	Tensile strength kg./mm²	Elongation min. per cent		
Most used steel qualities	Weicheisen	11	28–30	45	30	40–50	15	Armco	Armco
	Mb K6*	23	34–38	30	40	50–65	10	—	—
	Ck 10 bzw. Cq 10	25	36–40	25	40	50–70	10	XC 10 f	C 1010
	Ck 15 bzw. Cq 15	28	40–45	20	50	60–70	8	XC 12 f	C 1015
	Ck 22 bzw. Cq 22	30	42–50	18	55	65–75	7	XC 18 f	C 1020
	15 Cr 3 (EC 60)	30	40–50	18	50	60–70	8	12 C 3 u. 18C3	5115/5120
Steels used in certain cases, for a certain range of shapes	Ck 35	32	42–50	18	60	70–80	6	XC 35 f	C 1035
	Ck 45	34	50–60	16	65	75–85	6	XC 45 f	C 1045
	16 Mn Cr 5	34	42–50	18	50	65–75	8	16 MC 3	—
	20 Mn Cr 5	35	43–52	18	55	66–78	8	20 MC 5	—
	15 Cr Ni 6	36	45–55	18	60	70–80	8	16 NC 6	3115
	17 Cr Ni Mo 6	36	45–60	18	60	70–85	8	—	—
	41 Cr 4	40	60–75	18	65	75–85	8	32 C4, 38 C4	5130, 5140
	30 Cr Mo V 9	45	60–75	16	65	80–90	6	—	—
	27 Cr Al 6	45	70–75	16	65	80–90	6	—	—
Rust- and acid-resisting steels	X 8 Cr Ni 12 12	20	50–65	55	60	80–90	6	—	—
	X12 Cr Ni 18 8	25	55–75	50	65	85–95	6	—	—
	X 5 Cr Ni 18 9	22	55–70	50	60	80–90	6	—	—
Steels processed to bolts of all kinds	40 Mn 4	35	60–75	16	55	70–80	8	45 M 5	1041
	30 Mn 5	40	60–70	18	60	70–80	8	—	—
	37 Mn Si 5	40	65–75	18	60	75–90	8	38 Ms 5	—
	42 Mn V 7	35	65–80	18	65	80–95	8	—	—
	34 Cr 4	35	55–65	18	70	75–90	8	32 C4 u. 38 C4	5140 u. 5130
	36 Cr 6	45	60–75	12	70	75–90	8	—	—
	25 Cr Mo 4	45	60–70	14	60	70–80	10	25 CD 4	4120/4132
	34 Cr Mo 4	50	65–75	14	70	80–90	10	35 CD 4	4135
	42 Cr Mo 4	50	65–75	14	75	90–100	8	42 CD 4	4140/4142
	42 Cr V 6	45	65–75	12	60	70–80	10	40 CV 4	—
	50 Cr V 4	45	70–80	14	65	80–90	8	50 CV 4	6150
Anti-friction bearing steel	105 Cr 2	45	70–80	12	65	80–90	6	—	—
	105 Cr 4	45	70–80	12	65	80–90	6	—	—
	100 Cr 6	45	60–75	12	65	80–90	6	100 C 6	52 100

* Al Killed (open hearth steel) max 0.1 per cent C ; 0.03–0.1 per cent Si ; 0.2–0.4 per cent Mn ; max. 0.03 per cent P ; max. 0.04 per cent. S.

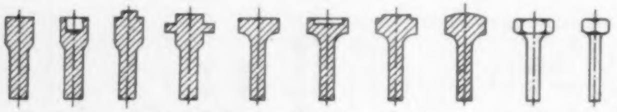


Fig. 3.—Solid components with different heads

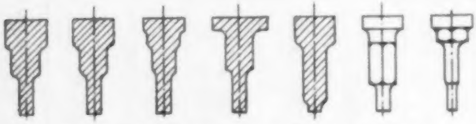


Fig. 4.—Solid components with stepped shafts

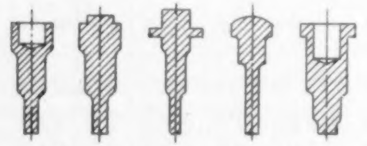


Fig. 5.—Combination of characteristics of Figs. 3 and 4

ment available and installed. This differs, therefore, with the various manufacturers. Today components in lengths of 0.19 in. to 47 in. and o.d. of 0.1 to 6 in. are economically produced and sold. Depending on the equipment installed the manufacturer will accept orders within the total range or within a narrower range. His competitiveness will further depend on his means to execute an order on universal or special installations. Therefore:

(*a*) Allow the producer the freedom to make his choice between one or two alternatives as to shape, or contact the expert in time to have his advice in making the design. You profit by getting the most economical proposition.

(*b*) Avoid asking for a special shape where standard shapes produced by the cold-forging process might do.

(*c*) Try to solve a given problem without leaving the range of axially symmetrical shapes. Avoid complicated shapes. In many cases it is more economic to execute a design in two components welded together afterwards. Lugs, *e.g.*, can more easily be added by welding. On the other hand, the process makes it possible in many cases to execute a design in one component that has been produced in several elements by other processes before.

Dimensional Accuracy and Tolerances

Tables III, IV and V show the minimum range of tolerances achievable in normal production as well as by introducing additional calibrating operations. In the interest of reasonable cost, additional operations should be avoided. If imperative technical reasons call for narrower tolerances as indicated, cold-forged parts often become uncompetitive due to the need for subsequent machining operations. It then has to be checked whether machining the part totally would not be cheaper than to cold-forge and machine it. If the result is favourable to cold forging it is necessary to provide for sufficient allowance for the following machining operations.

Tolerances in the slug make it necessary to allow for large tolerances in length at the end of the part to which the metal is forced to flow when put under pressure in an open die, thereby changing its former diameter. As Tables III to V show, it is necessary at least to allow tolerances for total length of 0.12 in. to 0.24 in. respectively. If such tolerances cannot be allowed it is necessary to cut to length. Then the designer should aim at including any other machining that might be necessary in one operation when cutting to length.

Eccentricity, that is, central deviation of outside diameter D from internal diameter *d* must be acceptable in the range of 0.5 to 12 per cent of nominal diameter D. Out of roundness must be acceptable in the range of 0.2 to 0.6 per cent of the inner or outer nominal diameter.

Flexure values vary with the length or height of the part. They can be neglected in the case of hollow shapes. The values for solid shapes are given in Table III.

Deviations in bottom thickness and thickness of flanges are due to tooling and to play in the press.

Indications as to their importance are given in Tables IV and V.

Fig. 6.—Tubular shapes and cupped shapes pre-sized, coined and punched-out bottom

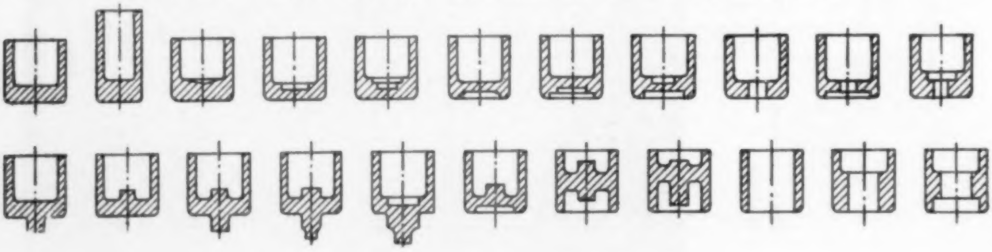


TABLE III—*Deviations from nominal size taken from cold-forged solid components*

Size (diameter) d		Difference of diameter				Lengths l		Permanent set F	
		Normally obtainable		Obtainable by additional operation					
mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.
10–20	0.4–0.8	±0.05	±0.002	±0.008	±0.0003	under 100	under 3.9	0.02–0.15	0.0008–0.006
20–30	0.8–1.2	±0.07	±0.0003	±0.03	±0.001	over 200	over 7.8	0.05–0.25	0.002–0.01
30–50	1.2–1.9	±0.08	±0.0032	±0.04	±0.0016	over 500	over 20	0.1–0.5	0.004–0.02
50–80	1.9–3.2	±0.10	±0.04	±0.08	±0.003	over 700	over 28	0.2–1.5	0.0008–0.06
80–100	3.2–3.9	±0.12	±0.05	±0.09	±0.0035	over 1200	over 48	0.5–2.0	0.02–0.08

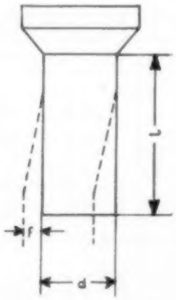


Diagram showing dimensions referred to in Table III

Tool life is relatively good in cold forging. The inevitable influence of tool wear on tolerances can still be minimized by occasional touch-up or exchange of dies and punches.

All data given on tolerances for eccentricity, out of roundness, flexure, deviations in bottom and flange thickness as well as for tool wear apply to results achieved with commercial machines and tool steels. Even better results can be achieved with special equipment and the occasional use of tungsten-carbide tools. As the data apply to the average producible shapes it is advisable to discuss tolerances in detail with the manufacturer if a part offers particular technical problems.

Therefore, it is preferable to specify to the manufacturer only those tolerances that if exceeded would render the component useless.

Surface Condition

In the cold-forging process the workpieces are phosphated to decrease friction during cold-working operations. The hardening effect of cold forging operations, together with the remaining phosphate layer, yield an extremely good surface.

The remaining phosphate layer further inhibits the component against corrosion, an advantage if parts are stored or shipped. The phosphate layer is a disadvantage if the cold-forged parts have to be soldered, brazed or welded, and therefore the layer has to be removed, but this, in most cases, will spoil the excellent surface condition as roughness is increased.

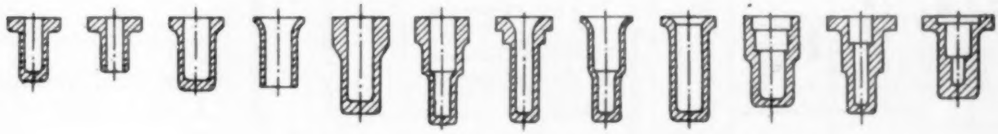


Fig. 7 (above).—Hollow shapes with stepped wall

Fig. 8 (below).—Combinations of Figs. 6 and 7

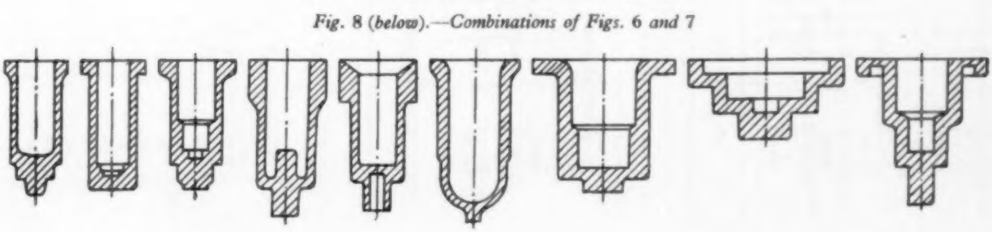


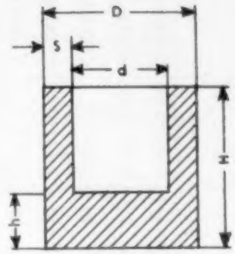
TABLE IV—*Deviation from nominal size taken from cold-forged cups*

Wall thickness

Nominal size S		Deviation from S: Normally obtainable		Deviation from S: Obtainable by additional operation	
mm.	in.	mm.	in.	mm.	in.
under 2	under 0.1	±0.1	±0.004	±0.05	±0.002
2–10	0.1–0.4	±0.15	±0.006	±0.10	±0.004
10–15	0.4–0.6	±0.2	±0.008	±0.15	±0.006

Bottom Thickness

Nominal size h		Deviation from h: Normally obtainable		Deviation from h: Obtainable by additional operation	
mm.	in.	mm.	in.	mm.	in.
under 2	under 0.1	±0.15–±0.2	±0.006–±0.008	±0.1	±0.004
2–10	0.1–0.4	±0.2 –±0.3	±0.008–±0.012	±0.15	±0.006
10–15	0.4–0.6	±0.25–±0.3	±0.010–±0.012	±0.2	±0.008
15–25	0.6–1.0	±0.3 –±0.4	±0.012–±0.016	±0.25	±0.010
25–40	1.0–1.5	±0.4 –±0.5	±0.016–±0.020	±0.35	±0.014



(*Above*) *Diagram showing dimensions to which reference is made in Table IV*

Nominal size D		Outer Diameter (D) – Deviation from D: Normally obtainable		Outer Diameter (D) – Deviation from D: Obtainable by additional operation		Inner Diameter (d) – Deviation from d: Normally obtainable		Inner Diameter (d) – Deviation from d: Obtainable by additional operation	
mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.
under 10	under 0.4	±0.08	±0.003	±0.05	±0.002	±0.1	±0.004	±0.05	±0.002
10– 30	0.4–1.2	±0.1	±0.004	±0.06	±0.0025	±0.1 –±0.2	±0.004–±0.008	±0.05–±0.1	±0.002–±0.008
30– 40	1.2–1.5	±0.12	±0.005	±0.07	±0.003	±0.15–±0.25	±0.006–±0.010	±0.1 –±0.15	±0.004–±0.006
40– 50	1.5–2.0	±0.15	±0.006	±0.1	±0.004	±0.2 –±0.25	±0.008–±0.010	±0.1 –±0.15	±0.004–±0-006
50– 60	2.0–2.4	±0.20	±0.008	±0.12	±0.005	±0.2 –±0.3	±0.008–±0.012	±0.12–±0.2	±0.005–±0.008
60– 70	2.4–2.75	±0.22	±0.009	±0.15	±0.006	±0.2 –±0.3	±0.008–±0.012	±0.15–±0.25	±0.006–±0.010
70– 80	2.75–3.2	±0.25	±0.010	±0.17	±0.007	±0.2 –±0.35	±0.008–±0.014	±0.15–±0.25	±0.006–±0.010
80– 90	3.2–3.5	±0.30	±0.012	±0.2	±0.008	±0.25–±0.40	±0.010–±0.016	±0.2 –±0.3	±0.008–±0.012
90–100	3.5–3.9	±0.35	±0.014	±0.22	±0.009	±0.3 –±0.45	±0.012–±0.018	±0.25–±0.35	±0.010–±0.014
100–120	3.9–4.7	±0.40	±0.016	±0.25	±0.010	±0.35–±0.5	±0.014–±0.020	±0.3 –±0.4	±0.012–±0.016

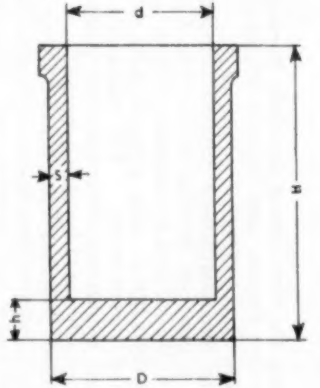
TABLE V—*Deviations from nominal size taken from cold-forged cartridge cases*

Wall Thickness

Nominal size S		Deviation from S: Normally obtainable		Deviation from S: Obtainable by additional operation	
mm.	in.	mm.	in.	mm.	in.
under 0.6	under 0.025	±0.05–±0.1	±0.002 – ±0.004	±0.02	±0.0008
0.8–1.2	0.03–0.05	±0.07–±0.1	±0.0027–±0.004	±0.02	±0.0008
1.2–2.0	0.05–0.08	±0.10–±0.15	±0.004 – ±0.006	±0.025	±0.001
2.0–3.5	0.08–0.14	±0.12–±0.15	±0.0047–±0.006	±0.030	±0.0012
3.5–6.0	0.14–0.24	±0.15–±0.2	±0.006 – ±0.008	±0.040	±0.0016

Bottom Thickness

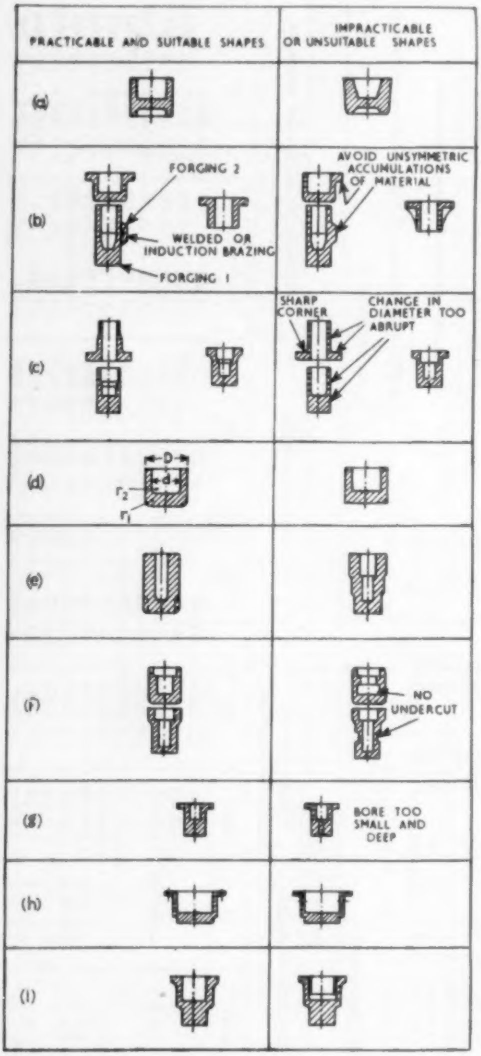
Nominal size h		Deviation from h: Normally obtainable		Deviation from h: Obtainable by additional operation	
mm.	in.	mm.	in.	mm.	in.
under 2	under 0.1	±0.15	±0.006	±0.1	±0.004
2–10	0.1–0.4	±0.20–±0.3	±0.008 – ±0.012	±0.12	±0.005
10–15	0.4–0.6	±0.25–±0.35	±0.010 – ±0.014	±0.15	±0.006
15–25	0.6–1.0	±0.3 – ±0.4	±0.012 – ±0.016	±0.20	±0.008
25–40	1.0–1.5	±0.35–±0.5	±0.014 – ±0.020	±0.25	±0.010
40–50	1.5–2.0	±0.40–±0.5	±0.016 – ±0.020	±0.30	±0.012
50–70	2.0–2.8	±0.45–±0.6	±0.018 – ±0.025	±0.35	±0.014



(*Above*) *Diagram showing dimensions to which reference is made in Table V*

Outer Diameter (D) / **Inner Diameter d**

Nominal size D		Deviation from D: Normally obtainable		Deviation from D: Obtainable by additional operation		Deviation from d: Normally obtainable		Deviation from d: Obtainable by additional operation	
mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.
under 10	under 0.4			±0.02	±0.0008	±0.05	±0.002	±0.02	±0.0007
10–30	0.4–1.2			±0.02	±0.0008	±0.05–±0.07	±0.002–±0.0027	±0.02 – ±0.04	±0.0007–±0.0015
30–40	1.2–1.5	±0.1	±0.004	±0.02	±0.0008	±0.08–±0.10	±0.003–±0.004	±0.02 – ±0.04	±0.0007–±0.0015
40–50	1.5–2.0			±0.025	±0.0010	±0.10–±0.12	±0.004–±0.005	±0.25 – ±0.04	±0.0008–±0.0015
50–60	2.0–2.4			±0.030	±0.0012	±0.12–±0.14	±0.005–±0.006	±0.03 – ±0.05	±0.0012–±0.002
60–70	2.4–2.8			±0.035	±0.0014	±0.15–±0.18	±0.006–±0.007	±0.035–±0.05	±0.0014–±0.002
70–80	2.8–3.2	±0.2	±0.008	±0.040	±0.0016	±0.18–±0.20	±0.007–±0.008	±0.04 – ±0.05	±0.0015–±0.002
80–90	3.2–3.6	±0.3	±0.012	±0.05	±0.002	±0.20–±0.24	±0.008–±0.009	±0.05 – ±0.08	±0.002 – ±0.003
90–100	3.6–3.9			±0.06	±0.0024	±0.25–±0.30	±0.010–±0.012	±0.06 – ±0.09	±0.0023–±0.0035
100–120	3.9–4.7	±0.3	±0.012	±0.08	±0.003	±0.30–±0.40	±0.012–±0.016	±0.08 – ±0.1	±0.0031–±0.004
120–140	4.7–5.5	±0.4	±0.016	±0.12	±0.005	±0.40–±0.50	±0.016–±0.020	±0.1 – ±0.12	±0.004 – ±0.005



Therefore, components should be designed so that the excellent surface of the cold-forged part remains unimpaired to profit from this advantage of the process.

Designing the Component for Cold Forging

1.—*Prototype Drawing and Prototype Production Sample*

File to the manufacturer together with the enquiry a prototype drawing showing the final shape of the requested component. Show all sectional views true to scale, giving all radii, etc., with exact measurements. The manufacturer cannot get the necessary information by samples or sketches only. Add for his information :—

(*a*) Physical properties required (tensile strength, yield stress, hardness, elongation) and, if intended, what subsequent heat treatment will be applied (case hardening, hardening with subsequent tempering), so that the manufacturer can propose the most suitable steel quality.

(*b*) Which tolerances are imperative and could not be extended.

(*c*) Desired surface condition and if intended what subsequent surface treatment will be applied.

(*d*) To what extent changes in shape could be tolerated to facilitate cold-forging operations.

(*e*) Estimate on quantities needed, delay of first delivery and scope of partial lots and their sequence.

With all these details on hand the manufacturer can decide whether the component can technically add economically be produced by the process. If the decision is positive a prototype drawing of the possible shape in the cold-forged condition will

Fig. 9.—Rules for designing cold-forged components.

(a) Tapering walls in general are not necessary. In case of long components with irregular wall thickness they may ease ejection from the die.

(b) Avoid considerable accumulations of material at a certain area, especially unsymmetrical accumulations. As it is inappropriate or even impracticable to build up ribs or webs by cold forging these normal expediences are no solution. If the design imposes considerable accumulation of material at a specific area then it should be attached by welding.

(c) Avoid repeated and abrupt sectional transition from one diameter to another. Let the diameter change in measured steps or lead over by sufficiently soft radius.

(d) Allow the largest possible radius for any rounding at the brim of edges and grooves. It influences tool life considerably and thereby costs. Too small a radius at the brim of an edge or groove involves greater wear and in case of deeper grooves it may cause notch cracks. Table VI shows the minimum values for radii separately for normal and for precision jobs. Precision work is always more costly. It is advisable to leave a certain freedom to the manufacturer so that he can adapt the radii to the exigencies of the process. In some cases small radii are welcome but then lapping cannot be completely avoided. Height of component = H. Thickness of base of component = h.

(e) Avoid unimportant changes in inner or outer diameter. Otherwise tool life would be shortened so that cost may rise out of proportion. Machining will solve such problems much more economically. Greater differences of diameter are acceptable.

(f) Avoid any inner or outer undercut. Machining is a cheaper means to produce them.

(g) It is uneconomic to forge bores of a diameter less than 0.39 in., especially if they are deep (rule: 1.5 times diameter). It is better to have them drilled.

(h) It is impossible to forge vertical bores. Small holes in flange and bottom can be blanked (rule : thickness of bottom or flange < 1.2 times diameter of hole).

(i) Threads cannot be made by cold forging. It is, however, possible to assure so precise outer or inner diameter that only the profile of the thread remains to be machined or rolled.

TABLE VI—*Internal and External Radii*

Diameter D or d Length H or h				External radius r_1				Internal radius r_2			
Over		Up to		Normal		Precise		Normal		Precise	
mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.
—	—	10	0.4	0.5-2.0	0.02-0.08	0.3-1.0	1.012-0.04	1.0- 3.0	0.04-0.12	0.5-1.5	0.02-0.08
10	0.4	25	1.0	0.7-2.0	0.03-0.08	0.5-1.5	0.02-0.06	1.5- 4.0	0.06-0.16	0.7-2.0	0.03-0.08
25	1.0	50	2.0	1.0-3.0	0.04-0.12	0.7-2.0	0.03 -0.08	2.0- 5.0	0.08-0.20	1.0-3.0	0.04-0.12
50	2.0	80	3.2	1.5-5.0	0.06-0.20	1.0-3.0	0.04 -0.12	2.5 -7.0	0.10-0.28	1.5-5.0	0.06-0.20
80	3.2	120	4.7	2.0-6.0	0.08-0.24	1.5-5.0	0.06 -0.20	3.0 -9.0	0.12-0.36	2.0-7.0	0.08-0.28
120	4.7	160	6.3	3.0-9.0	0.12-0.36	2.0-8.0	0.08 -0.32	4.0-10.0	0.16-0.40	3.0-9.0	0.12-0.36

be forwarded with the quotation. Close co-operation between producer and buyer is desirable to make both interests match as far as possible. Once agreement is reached, the producer will start to design and make the tooling and to set the operation schedule. Mass production should never be given the " green light " until the prototypes of the part produced by the necessary try-out of the tools have been checked and accepted by the buyer.

Therefore, decide on the final shape of the cold-forged component in co-operation with the manufacturer and check by prototype samples whether expectations are realized before mass-production starts, as improvements can often be reached when the experience of the tool try-out is available.

2.—*Tool Cost*

Tooling comprises punches, dies and cutting dies for the various press operations of a specific part

(*Continued in page* 334)

Fig. 10.—Examples of cold-forged components

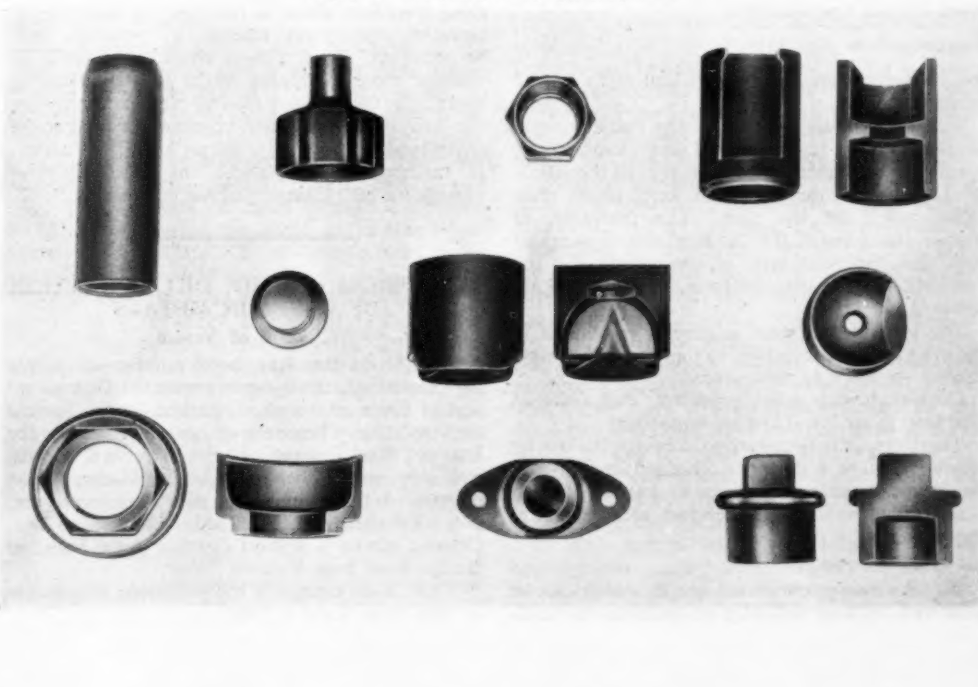


Fig. 11.—Some further examples of cold-forged components

forging technique. It is possible to press marks, lugs, inscriptions, elevations and depressions into the bottom of the component. They can be arranged symmetrically (inner or outer indentations, grooves, etc.) or unsymmetrically.

It is necessary, therefore, to try to keep the design in the range of shapes shown, as any additional problems cause higher costs.

4.—*Subsequent Treatment of Cold- Forged Parts*

As said before, for economic reasons an attempt should be made to forge the component as close to its final shape as possible. In many cases, however, subsequent machining operations will be necessary. Then a check should be made as to whether more machining might save cold-forging operations. Should any trouble occur in machining the cold-forged part, then variations of the cutting angles will help. If not, ask an expert for advice. If machining is inevitable the designer must provide for easy clamping of the component.

Cold-forged Components

(*Continued from page* 333)

and reinforcements and fixtures that often can be universally used.

It is the practice of most of the manufacturers to charge part of the initial tool costs (steel, wages, overheads, commission and sales tax) to the customer. Normally they will not keep secret their "know-how" on the tools. The customer, of course, can request that no-one else is supplied with this particular type of component and the manufacturer will agree if no standard shapes are involved.

The cost of tool wear is generally included in the price of the component, so that no further extra charges are made to the customer.

Compared with other processes, tool costs in cold forging are low if lots are important.

Therefore, it is necessary to consider the matter seriously before a design is changed and discuss it with the supplier, as a change in design will mean a new set of tooling and therefore new charges to the customer.

3.—*Rules for Design*

Fig. 9 shows symmetrical shapes which can be produced without difficulty in applying the cold-

SYMPOSIUM ON THE DETERMINATION OF GASES IN METALS

Change of Venue

OWING to the very large number of people registered, the Symposium on the Determination of Gases in Metals, organized by the Society for Analytical Chemistry in conjunction with the Iron and Steel Institute and the Institute of Metals, will now *not* be held at Church House, Westminster. It has been transferred to: Denison House, 296, Vauxhall Bridge Road, London, S.W.1. Denison House is a short distance down Vauxhall Bridge Road from Victoria Street.

There is no change in the published programme or date (May 3 and 4, 1960).

SOME TRENDS IN POWER-PRESS DESIGN*

By E. C. SEED†

THE main consideration in designing a range of power presses is to find a uniform basis of design to cover machines from small open-fronted models to the larger 500-ton and upwards double-sided panel presses for the motor-car industry.

It appeared in the early days that experience and expediency dictated the proportions of power presses rather than scientific principles, and thus presses of the same rated capacity might well have very widely different proportions.

Consequently the author considered first principles of machine design and from this adopted a uniform basis for the proportions of all the power presses manufactured by his company, and although the basis of proportions may not have been correct, all the machines had a uniformity of proportion and withstood arduous duty and overloading, by no means an exceptional feature in the press shops of this country.

Today there is more general similarity in the proportions of power presses built by most manufacturers of repute and so it would appear that all manufacturers work on more or less the same basis.

In the motor-car trade on large panel presses it is now generally accepted that when a 200-ton or a 500-ton press is called for then the press should be so designed that the rated tonnage is assumed to be applied during the last ½ in. of the downstroke of the machine. By so doing a most useful basis of comparison is arrived at.

As the basic principle of a power press is to store energy in a flywheel and extract concentrated "doses" of power as required the first design consideration is so to proportion the flywheel that by applying a 20 per cent speed drop during the power stroke sufficient energy is released to the press ram so as to apply the rated tonnage through the last ½ in. of the power stroke. A 20 per cent speed drop yields 36 per cent of the energy stored in the flywheel and thus the motor driving the press should be rated so that it is capable of restoring this energy back to the flywheel during the idle portion of the working cycle. It should be remembered that on a continuously running press this energy must be put back into the flywheel during the idle portion of one revolution, whereas on a large double-sided panel press which performs a stroke and is then stopped while the finished component is lifted out and the next blank put into position, there is necessarily a much longer time for the motor to put back the energy into the flywheel so in this case the motor can be relatively smaller in dimensions.

The rated tonnage at ½ in. from bottom of stroke also provides a basis of working out the crankshaft or eccentric torque, the proportions of the gearing and the rest of the transmission. The rated tonnage also permits the deflexion and the strength of the bed and the ram to be reasonably calculated and it determines the size of the tie rods if the machine is of this type. Here it should be remembered that the tie rods are pre-stressed to give a squeeze on the press frame in excess of the rated capacity of the machine and so the tie rods should be so designed that they will withstand a load approximately 2½ times the rated capacity of the press.

When a planning engineer is deciding what tonnage of press to recommend for a given operation it is as well to bear in mind the above-mentioned convention for a general-purpose press of rating the machine during the last ½ in. of the working stroke. If, however, the load is applied higher up the stroke and through a longer period than the last ½ in. then the tonnage which can be exerted will be proportionally reduced. For instance, to produce a component such as a motor-car door which may have a 4-in. draw, calculations may show that a force of 150 tons is required to do the job. This may be made up as follows :—

50-tons cushion load which is the actual force required to draw the blank plus 100 tons to fix the shape of the component.

In this case a correct assessment of power requirements might well be 50 tons through 4 in., which is 200 in.-tons, plus a bottoming load of 100 tons through, say, ⅛ in. which is 12 in.-tons.

* Based on a Paper read to the Birmingham Productivity Association in September, 1959.

† Cowlishaw Walker and Co. Ltd.

Fig. 1.—An 800-ton four-point suspension press at Carbodies Ltd., Coventry

Thus the total energy requirement would be 212 in.-tons.

This requirement would, therefore, call for a press capable of exerting a pressure well in excess of 150 tons and providing 212 in.-tons energy. This, on the accepted rating described above, would call for a 424-ton or preferably a 450-ton press having at least a 10-in. stroke.

The figures given for a door panel are hypothetical only, and it does not necessarily follow that any motor-car door panel requires a 450-ton press to produce it.

In actual practice a capable man might well take a look at a component, visualize the operation and from experience be able to say there and then —" this job should go on such and such a press."

The author is not belittling systems based upon calculations but he does respect experience. In the case of blanking, coining and specific deep-drawing operation of rectangular or circular shapes the tonnage and energy requirements can now be much more accurately assessed.

It should be remembered, however, that on a small open-fronted press the rated tonnage may only apply through the last $\frac{1}{4}$ in. or $\frac{1}{8}$ in. of the stroke, as against the conventional $\frac{1}{2}$ in. of the bigger machines.

During the past 20 years much thought has gone into arriving at simple and reliable formulae for computing tonnage and energy values for various press operations to replace rule-of-thumb and trial-and-error methods which, incidentally, were based upon the vast experience which had been gained by users and manufacturers of power presses over several generations.

Just before the war the author was faced with the task of designing power presses to undertake heavy operations on the cupping and drawing and also indenting and heading of large ordnance cartridge cases. Accordingly, in conjunction with the engineering department of Woolwich Arsenal, an empirical system was developed which, when used with judgment, was reasonably accurate and from this basis it was possible to design the range of large cartridge-case presses which the author's company supplied to various ordnance factories during the war.

At the end of the war the Motor Industry Research Association thought it would be of great value to the industry to investigate the basic problem of studying the behaviour of metals under deep-drawing conditions and to arrive at an exact basis of calculation for this operation. They instituted a special deep-drawing panel composed of authorities from the leading users of power presses in this country and in due course they decided to sponsor fundamental research into deep-drawing problems—the work to be carried out under the direction of Professor H. W. Swift, M.A., D.Sc. (Eng.), at Sheffield University. A hydraulic press was provided for experimental work and also a variable stroke and variable speed crank press, the latter being specially designed and built for the purpose by the author's company in 1946. A description of this experimental crank press may be found in the Proceedings of the Institution of Mechanical Engineers 1950, volume 163 (W.E.P. No. 58).

About this time much interest was shown in the technique of producing cylinders either rectangular or circular by means of the impact extrusion method. This subject was of such importance to Imperial Chemical Industries, Metals Division, that in 1948 they ordered a special crank press of rather larger capacity than the one installed at Sheffield University, for the sole purpose of research into impact extrusion.

Later on the Department of Scientific and Industrial Research also decided to undertake research into impact extrusion and they put in equipment at their East Kilbride establishment for this purpose. For their mechanical experiments they installed in 1955 a similar press to the one which the I.C.I. had been working with in Birmingham. All three machines were proportioned through experience gained during the war in the manufacture and use of presses for the production of large ordnance cartridge cases.

So far the technicalities of the trends in press design and in the computation of power and energy requirements for the production of given components have been considered, but the important question of safety to press operators must not be forgotten.

"The question of the prevention of accidents between the punch and die on power presses has engaged the attention of industry on a very wide scale and in many diverse manufacturing processes for many years," so said H.M. Chief Inspector of Factories in 1939. Following this, a committee was formed to study the problem in February, 1940, with Mr. H. R. Rogers, H.M. Deputy Chief Inspector of Factories as chairman and a representative body of members including press manufacturers, press users, safety appliance manufacturers, the Institution of Production Engineers and the Factory Department.

Much valuable work was done by this committee and as a result of their 1945 report it was decided to constitute a Joint Standing Committee to continue this work which is still actively investigating safety problems at the present time.

Technical sub-committees have been formed and have dealt with specific problems; to take one example: to prevent uncovenanted stroking or repeating on electro-pneumatic control systems of presses. This has been a very difficult problem because tracking down the prime cause of a repeat stroke on a press can be particularly difficult. Presses have run faultlessly year after year and then occasional repeats have occurred on systems which were formerly thought infallible.

Things which can cause repeats on electro-pneumatic clutches are dust in the air (which may clog a pilot valve), a sticking contactor and there has even been one case where a solenoid valve pulled in on an earth fault at less than half the rated voltage. Under-rating an electrical device can be just as dangerous as over-rating.

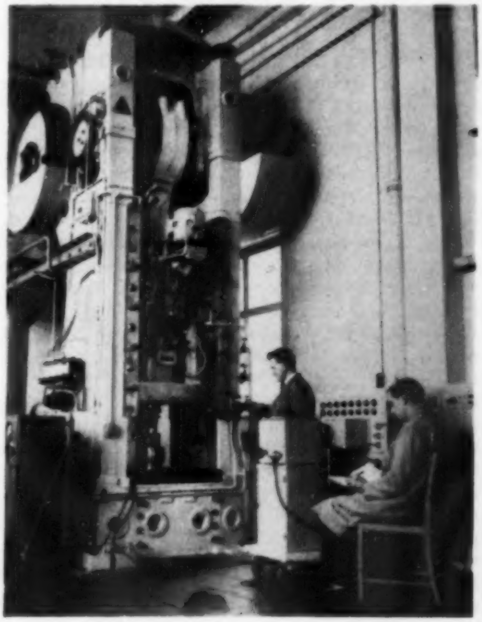
Within recent years a serious accident occurred on a 100-ton open-fronted press (manufactured by the author's company) fitted with an electro-pneumatic clutch and an interlocked operator's guard. According to the evidence available it was presumed that the press had repeated but even in the event of a repeat, the guard by virtue of its interlocking feature, would have been pulled into position and so have prevented the operator from receiving an injury.

The matter was investigated by the works safety engineer, H.M. inspectors and the manufacturers. The electro-pneumatic clutch system was found to be in perfect working order and likewise the interlocking feature of the operator's guard. The only conclusion which could be made was that the guard must have been tampered with in some way, but no proof could be found. However, the matter was not left in this uncertain state and two solutions were eventually found which would have the effect of still further reducing the possibility of such an accident occurring again.

First, the safety department of the factory where the press was at work, devised a special air valve which was connected to the operator's guard so that in the event of a repeat stroke being initiated with the guard open then the air supply to the clutch would blow off to atmosphere. This simple system has been adopted in the particular factory and has proved to be most effective.

The author's solution to this problem was to devise a monitoring circuit applied at the danger point in the clutch control sequence, that is just as the slide reaches top dead centre. Under this monitoring system the clutch circuit controls work normally until the critical period is reached, then the monitoring controls check the various relays and should the press attempt to perform a repeat stroke when it is not intended to do so, the air supply to the clutch control valve is automatically opened to exhaust thus failing to safety. By doing this electrically the system can be applied to presses of any size and in fact the monitoring system is used by the author's company throughout their electro-pneumatic clutch presses. This development

Fig. 2.—Research on impact extrusion with a Cowlishaw Walker press at the D.S.I.R. Laboratories at East Kilbride



in the interest of safety would not have been possible but for the work carried out by the Joint Standing Committee.

Electrical circuits can, however, become too complicated and the position is fast approaching where any further addition to press control circuits should only be made after very careful consideration.

Trends in Press Usage

The author is hesitant about expressing an opinion as to what are present trends in the employment of power presses; many so-called revolutionary changes are very little more than adaptations of current practice, but this is how all genuine progress is made, step by step in the light of experience.

There does appear to be a definite trend to apply more widely the system of gang tooling, that is to put a number of comparatively small tools under the ram of one large press so as to be able to do all the stages of a given component on one machine. Dependent upon the size of the component, moving the parts from one set of tools to the next set can be very simply done by hand; whether or not to use a mechanical transfer device should be decided on the merits of the particular application.

To show that gang tooling is by no means new the Austin Motor Co. Ltd., very early in the war made steel helmets with the full sequence of operations on one press 100-in. wide having a capacity of 250 tons.

As regards feeding devices the simpler they are the better. As an example two 400-ton presses, each carried two sets of cropping and piercing tools. Each press was originally arranged for mechanical feeding, the finished components dropping out into work baskets at the rear. As it was necessary for an operator to stand by each press to deal with the short ends of the cropped bars and properly to feed in the new bars, it was considered that he might as well be employed feeding the bars all the time instead of looking at them three quarters of the time.

There are, however, certain cases where careful consideration does show decided advantages from full mechanization. Such a one is a road-spring cropping and piercing operation at a large motor works. The press which does this work is fed by a stack of bars 45-ft. long brought direct from the rolling mill. A mechanical de-stacking device, together with the feeding device, are an integral part of the press sequence system and are controlled by push-button by the press operator. Once the bars are fed into the tools then the press cycle is initiated and in turn the bars are automatically pulled through in the correct lengths, cropped and pierced and dropped into suitable boxes, the whole sequence being automatic and thoroughly safe. The handling devices were designed (in co-operation with the author's company) and built by The Hymatic Engineering Co. Ltd., and the somewhat complicated electrical equipment was made by Square D Ltd.

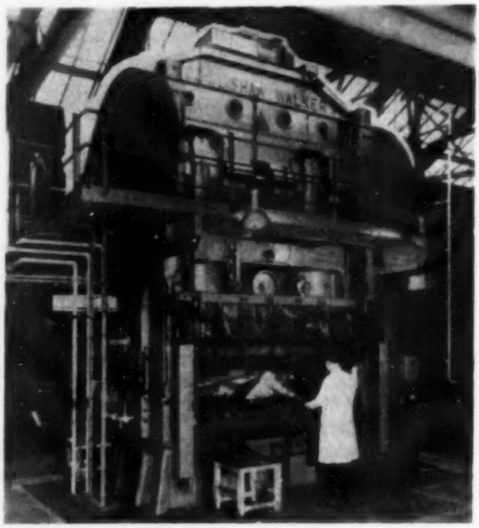


Fig. 3.—A 400-ton press producing gas fire components at the works of Bratt, Colbran Ltd., Wembley. (An example of gang tooling)

Power presses may be of the crank or eccentric type, they may have fabricated ring frames or cast-iron solid frames, they may have cast-iron frames with tie rods or fabricated frames with tie rods. Experience has shown that each type can have quite wide application and that one type may have advantages over another as well as disadvantages.

The term " appearance design " has been much talked about in recent years, particularly in reference to domestic appliances where attractive appearance to the housewife may well be the deciding factor in promoting a sale. This trend has created a new kind of specialist whose responsibility is for attractive appearance only, the rest of the job such as whether it actually works and how to make it at an economic price being done by ordinary engineers.

The Council of Industrial Design has shown much interest in this new work; at a conference held in Birmingham it was pointed out to large machinery manufacturers, including power-press manufacturers, that an attractive appearance had advantages and also the fact that specialist advisers were available for consultation. It was implied at this conference that the British designers of power presses and other large machines were quite oblivious of the appearance of their products. In the author's opinion, however, good functional

(*Continued in page* 374)

FINISH BLANKING

I

By F. HOWARD*

(A paper presented at the Annual Conference of the Institute of Sheet Metal Engineering, London, November 1959)

INTRODUCTION

THE rough sheared edge usually obtained on blanked components is often satisfactory for many purposes. When, however, the component is required to have a smooth edge condition, subsequent shaving or machining operations frequently become necessary. These extra finishing operations are sometimes slower than the initial blanking operation itself and may consequently control the rate at which a component is produced. It is evident, therefore, that an improvement in the sheared edge condition of a blanked component, resulting in the elimination of subsequent finishing operations, will be reflected in both the cost and speed of production.

The edge condition of thin blanked components can usually be improved by decreasing the clearance between the punch and die. As the material thickness increases, however, the edge condition of the component deteriorates, an acceptable finish being obtained only over a small portion of the edge, *i.e.*, the material first sheared by the die. The remainder of the sheared edge usually has a roughened appearance and tapers towards the punch, ending abruptly at a circumferential ridge or crack as shown in Fig. 9 (*a*).

As the clearance between the punch and die increases, the position of the ridge moves towards the top of the blank until a value of clearance is reached where it finally disappears. The sheared edge is then tapered towards the top face of the blank. The particular material thickness and clearance between the punch and die at which the ridge or crack appears, and the manner in which it subsequently expands, varies with the material and material temper.

Crack formation on the edge of blanked components may be suppressed by providing the shear edges of the blanking die with a small polished

* P.E.R.A.

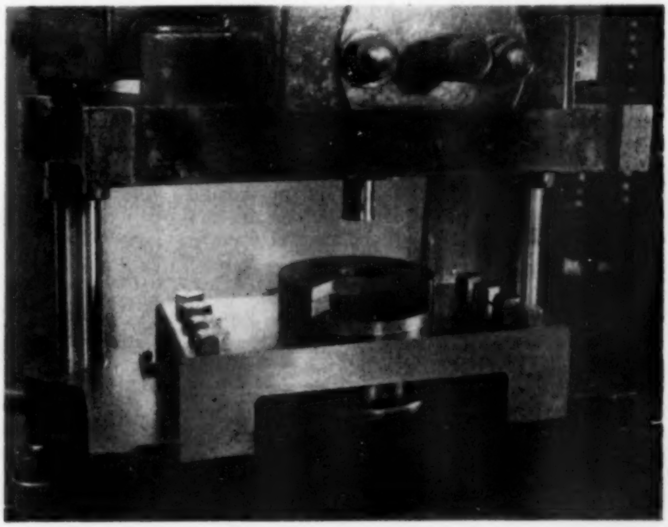


Fig. 1.—*Two-pillar blanking tool*

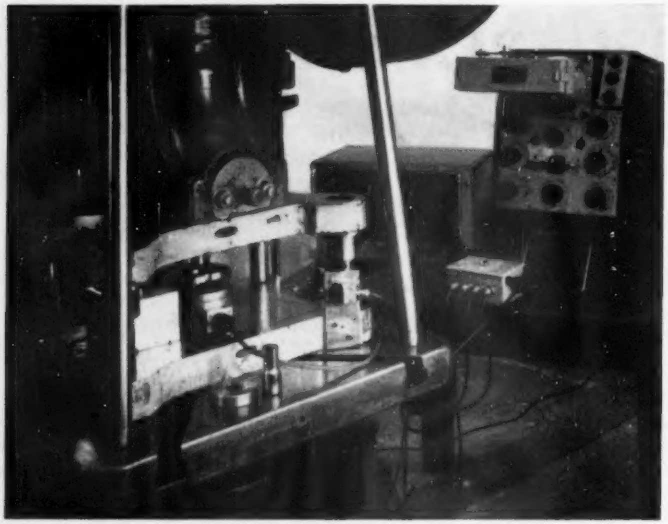


Fig. 2 (left).—Four-pillar blanking tool

Fig. 3 (below).—Typical force-penetration oscilloscope trace

radius. References to this method were first published some years ago in connexion with the manufacture of metal slugs for the impact extrusion process and for the production of small watch parts in soft ductile metals. However, it is believed that the technique has not hitherto been generally applied to blanking operations.

No information appears to be available concerning the combination of die radius with punch and die clearance to give the best edge condition for any given material or material thickness. Neither are the limitations of usefulness of the technique known.

It is with the aim of providing further information on the use of radiused dies for producing smooth and crack-free sheared edges, that this technique has been studied at PERA. Most of the tests have been carried out using aluminium alloy, copper and low-carbon steel, although observations have also been made on numerous other materials including alloy and high-tensile steels. The paper gives a description of the tests carried out, comments briefly on the mechanism of shearing and, finally, includes some notes on tooling requirements and typical components that have been finish blanked.

FINISH BLANKING TESTS

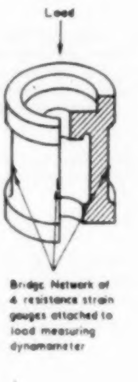
Equipment

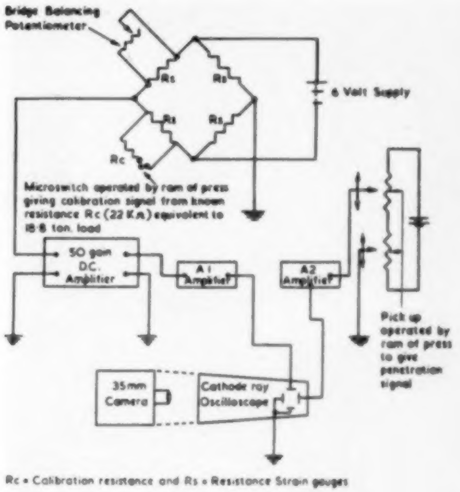
Tests were carried out on a 40-ton open-fronted crank press. Initially, a two-pillar type of blanking tool was used (Fig. 1) but difficulty was experienced in obtaining satisfactory alignment between punch and die during the operation and this tool was eventually discarded in favour of a more robust one built into a four-pillar die-set (Fig. 2).

The four-pillar blanking tool was provided with a dynamometer for blanking-force measurement which consisted primarily of a high-tensile steel compression cylinder for supporting the die and stripper plate assembly. The elastic deflection of the dynamometer induced by the blanking force produced a small voltage change in a bridge network comprising four resistance strain gauges which were cemented to the outside of the compression cylinder. This signal was fed to a d.c. amplifier and then to a cathode-ray oscilloscope, the signal appearing as a vertical displacement of a spot on the oscilloscope screen. Simultaneously, two wire-wound potentiometers which were rotated by movement of the press ram were used to produce an amplified horizontal displacement of the spot, the displacement being proportional to the punch travel. The variation in blanking force during the complete operation could, therefore, be represented on the screen of the cathode-ray tube as a force—penetration diagram of the type shown in Fig. 3. A known resistance, fixed across

Fig. 4 (right).—Diagram of dynamometer equipment

Fig. 5 (below, right).—Type of blanking punch used with four-pillar tool





one arm of the strain-gauge bridge and triggered by the ram of the press, was used to produce a calibration signal on each force-penetration diagram. A block diagram of the dynamometer equipment, which provided repeatability of the order of $\pm$ 2 per cent, is shown in Fig. 4.

Interchangeable punches of varying sizes were used with dies of 1-in. bore providing clearances ranging from 0.00025 in. to 0.0025 in. per side. The general form of the punches is shown in Fig. 5. The die throats were ground parallel for $\frac{1}{4}$ in. and then relieved at $\frac{1}{2}$ deg. per side. The radii at the mouth of the dies were polished with a fine grade of abrasive to obtain a good surface finish. The dimensions of the punches and dies, which were manufactured from a high-carbon, high-chromium tool steel, oil hardened to 60 Rockwell C, are shown in Table I.

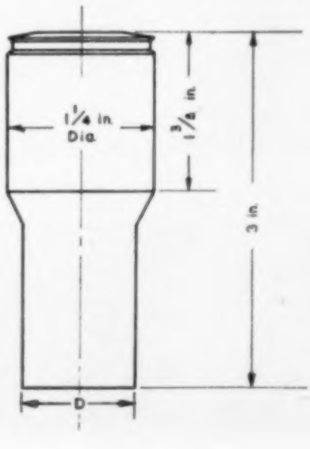
TABLE I—*Dimensions of Test Punches and Dies*

Die radius, in.	Punch diameter, in.	Clearance per side between punch and die of 1.000 in. bore, in.
0.000, 0.006	1.0000	0.000
0.010, 0.018	0.9995	0.00025
0.020, 0.025	0.9990	0.0005
0.035, 0.042	0.9980	0.001
0.055, 0.068	0.9950	0.0025
0.080	0.9900	0.005
	0.9750	0.0125

"Mechanism" of Shear

The mechanism of shear when blanking low-carbon steel material through square-and radiused-edge dies was studied by means of a metallographic sectioning procedure. A number of 2-in. square specimens were prepared from the test material and partially blanked, various penetrations of the punch into the material being obtained by varying the length of the press ram. Sections through the sheared zone were taken from each of the partially blanked specimens and these were then polished and etched for macroscopic examination.

In the case of the square-edge dies, the macrographs shown in Fig. 6 indicate the deformation of a relatively large volume of metal between the



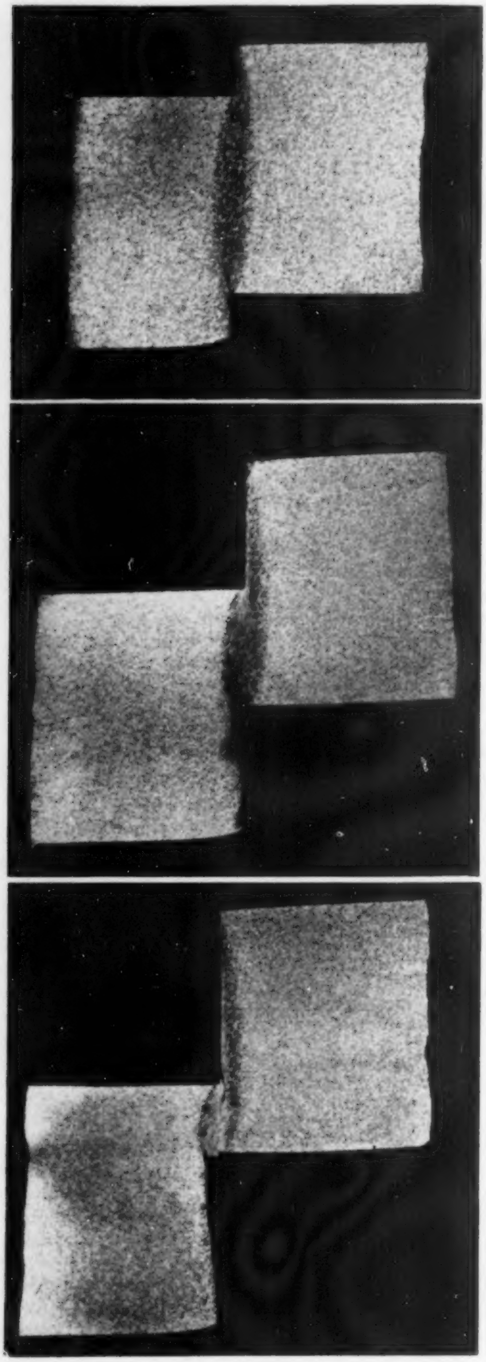


Fig. 6.—Macrosections showing deformed zone at various penetrations when using a sharp-edged die. (*a*) (*top*) *Penetration:* 23 *per cent metal thickness;* (*b*) (*centre*) *Penetration:* 56 *per cent metal thickness;* (*c*) (*bottom*) *Penetration:* 75 *per cent metal thickness*

tool edges very early in the punch penetration. The deformation is not sharply defined, as might be expected, but is diffused over a large area which in section appears as a long, rather sharply pointed ellipse. The points of the ellipse, at each end of the major axis, coincide with the tool edges and the greatest width is about 60 times the value of the clearance between the punch and die.

The curvature of the free unloaded surfaces of the stock and blank imply that large plastic flow has also occurred during the initial stages of the penetration. Measurements made across the sections show that severe work-hardening takes place in the elliptical region; this is greatest near the tool edges. Work-hardening to a lesser degree also occurs for some considerable distance into the blank and the stock.

The evenness of the sheared surface of the stock, and the land at the bottom of the sheared surface of the blank indicates that, in the early stages of penetration at least, the fracture of the metal immediately adjacent to the tool edges is around a plane connecting them. However, the formation of a relatively large region of deformed metal implies that this is not the mode of fracture obtaining throughout the entire thickness of metal.

It was observed that when the punch penetration had reached about one-sixth of the metal thickness, Fig. 6 (*a*), a crack formed in the blank, initiating from the die edge, and continuing along the periphery of the deformed region. At this stage the metal at the top surface of the blank immediately adjacent to the edge of the punch continued to shear along a plane parallel to the direction of punch travel.

As penetration progresses, Fig. 6 (*b*), the crack continues further into the blank, following the periphery of the work-hardened region. At this stage the crack has widened considerably.

With a punch penetration of 75 per cent of the metal thickness, Fig. 6 (*c*), a crack has developed on the upper or stop side of the hard region initiating at the punch edge. With further compression of the work-hardened metal, the cracks are arrested, and parting of the blank from the stock continues by shearing directly between the tool edges, the blank thus acquiring the character-

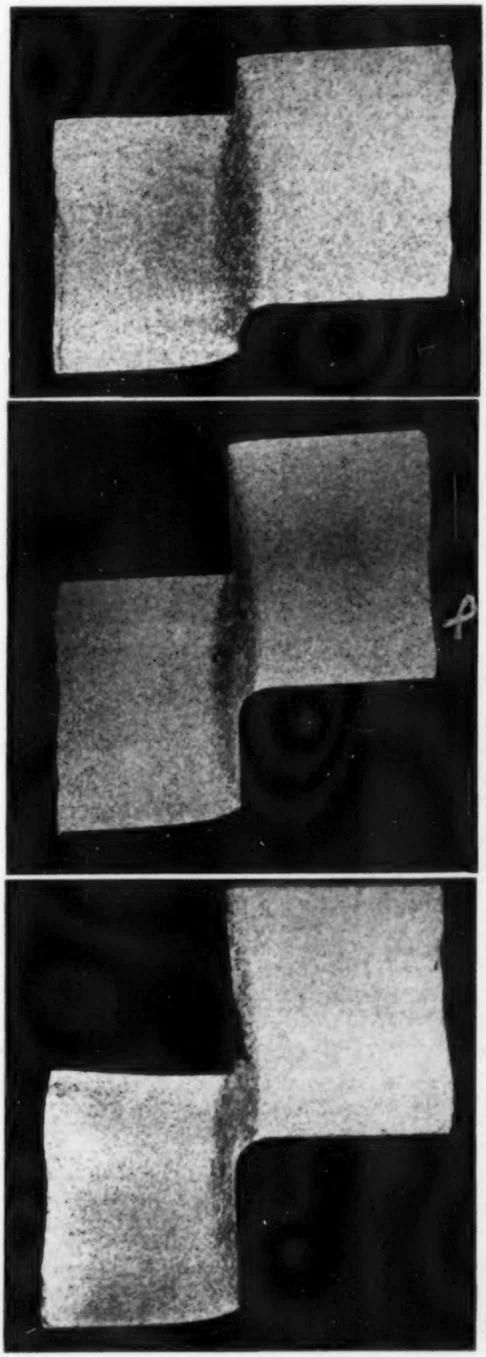


Fig. 7.—Macrosections showing deformed zone at various penetrations when using a radius-edged die. (a) (top) Penetration: 25 per cent metal thickness; (b) (centre) Penetration: 55 per cent metal thickness; (c) (bottom) Penetration: 76 per cent metal thickness

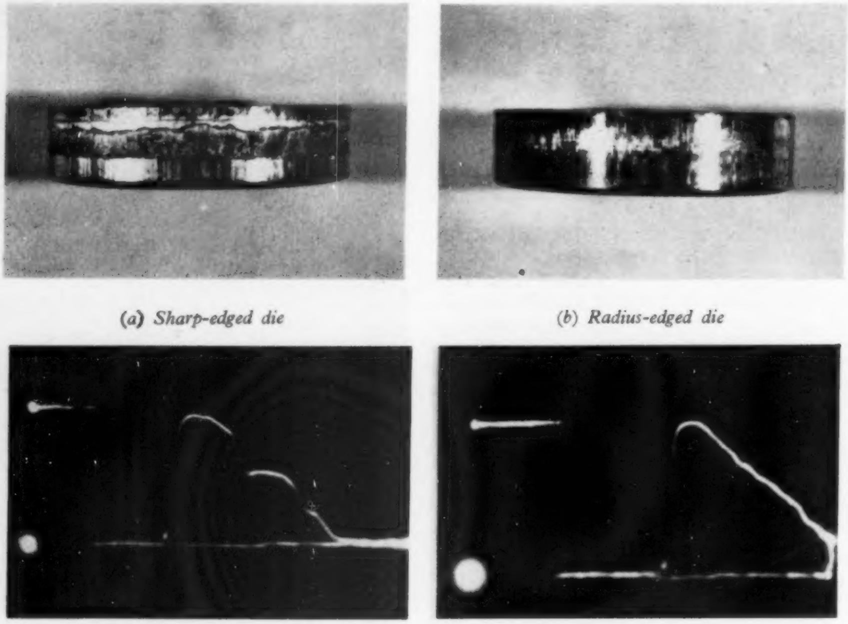
istic circumferential ridge where the abrupt change in the mode of fracture has taken place.

When blanking through a radiused-edge die, the initial deformation of the metal between the tool edges is similar in nature to that when blanking through a sharp-edged die except that the part of the work-hardened metal in contact with the die radius is broader and more diffuse. No cracking occurs at the die edge, and the macrograph in Fig. 7 shows that flow is continuous around a large part of the die radius. It was observed that when the punch has penetrated approximately half the metal thickness, a crack develops on the upper stock side of the work-hardened region, initiating from the sharp corner formed by the edge of the punch. As the punch continues to travel downwards, the crack widens, a consequence being that when the metal shears through the hardened region in the final stages of penetration, a second circumferential ridge is formed on the sheared surface of the stock.

No cracking appears on the surface of the blank and throughout the entire penetration the parting of the blank from the parent stock, at least in the material near the die edge, appears to be by shearing along a plane parallel to the punch travel.

Measurement and calculation from the known density of the material, shows that a blank produced by the sharp-edged die contains approximately 3 per cent less metal than a flat cylinder of equivalent diameter cut from the original bar. The diameter of the blank was equal to the punch, *i.e.*, smaller than the die bore. The thickness of the blank was measured in the centre and was found to be still equal to the thickness of unpierced stock. The centre thickness of a blank produced by the radius edged die, however, was found to be 0.005 in. greater than the unpierced stock. The amount of metal in the blank was less than 1 per cent smaller than that contained in a flat cylinder of equivalent diameter.

The results of these tests on low-carbon steel, when compared with those of previous work carried out to determine the mechanism of shearing in aluminium and copper[1], show that the mode of the fracture is similar for all the materials tested. When blanking with a sharp-edged die the work-hardened region promotes fracture by crack propagation, the cracks being initiated in locations of stress concentrations at the tool edges. Since the cracks



(a) *Sharp-edged die*

(b) *Radius-edged die*

Fig 8.—Condition of sheared surface and appropriate force-penetration diagram

appear to follow the periphery of the work-hardened region the final condition of the sheared surface is dependent to some extent on the width of the region, the wider the region the sharper the taper leading to the first ridge on the sheared surface. The fact that blanks having a smooth sheared surface can be produced in tin, lead and other materials that do not work-harden, and in hard-temper copper whose work-hardening capacity has been almost exhausted, seems to indicate that the condition of the sheared surface depends also on the work-hardening capacity of the material.

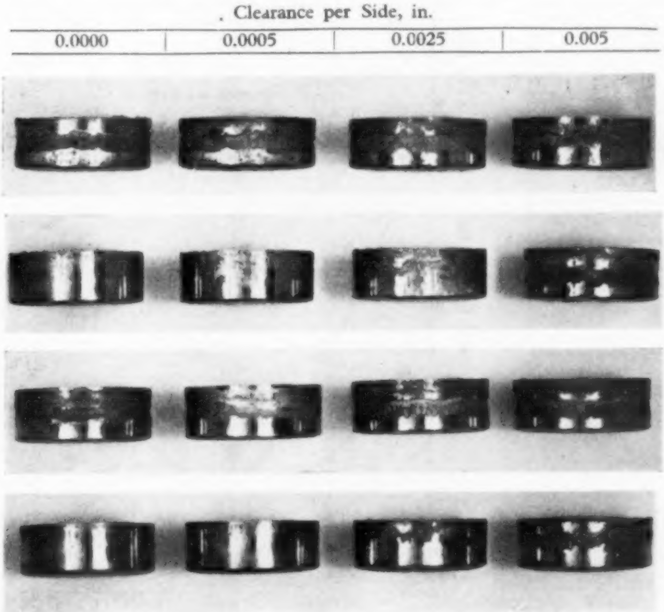
The relationship between the shape of the work-hardened region induced within the metal, and the capacity of the metal for work-hardening, has not been established; it is, therefore, impossible to estimate how much the condition of the sheared surface is influenced by this factor. It may well be that for some materials the shape of the work-hardened zone does not change, regardless of the previous amount of cold work done on the material, and the sheared surface of the blank produced from such a material would show little change as the work-hardening capacity of the metal is reduced.

The results of a recent series of tests on plain carbon steel showed that even a large amount of previous cold working would not induce a condition from which smooth sheared surfaces could be produced by sharp-edged dies.

In the macrograph in Fig. 7 (*b*), it is seen that the effect of radiusing the die edge is to suppress the cracking that would normally form at the die edge, and to induce fracture by shearing through the work-hardened region.

The thickening of the component mentioned earlier suggests that a large compressive stress exists in the region of shearing, and the suppression of cracks may be partly due to this. It can be seen in the macrographs of Figs. 6 and 7 that the end of the elliptical work-hardened region adjacent to the radiused die edge is broader than in the case of the sharp-edged die; this suggests that the concentration of stress may be lower than required for the initiation of incipient cracks.

It would seem that the die radius is effective in distributing the stresses in such a manner as to cause shearing to occur throughout the penetration in a narrow band of metal (the plane of which is through the centre of the work-hardened region, and in a direction parallel to the punch travel) the result being that a smooth crack-free sheared surface is produced. The condition of the sheared surfaces and the force-displacement diagrams obtained for sharp- and radiused-edge dies are shown together in Fig. 8. It is apparent from Fig. 8 (*a*) that the blanking load with the sharp die rises to a maximum early in the penetration and thereafter falls almost linearly with the thickness



(a)

(b)

(c)

(d)

Fig. 9.—Effect of clearance on condition of sheared surface when using radiused- and square-edged dies.

(a) Hot rolled; die radius = 0.000 in.; (b) hot rolled; die radius = 0.025 in.; (c) cold rolled; die radius = 0.000 in.; (d) cold rolled; die radius = 0.018 in.

remaining in the shear until cracking occurs within the metal. At this point, the load drops rapidly until the cracking is arrested and then remains almost constant until a second crack occurs within the metal, when it again drops rapidly. During the final stages of the operation, the load falls linearly with the thickness of metal remaining in shear.

The trace for the radiused-edge die (Fig. 8 (*b*)) shows that the blanking load, after rising rapidly to a maximum, falls linearly as penetration progresses. The load remaining after penetration is complete (shown at the right-hand end of the diagram) is that required to force the slug through the die where a certain amount of ironing is taking place.

Finish Blanking Conditions

Following the study of the mechanism of shearing, some additional blanking tests were carried out in order to determine the limiting values of die radius and clearance that would give satisfactory results. The effect of die radius and clearance on the sheared surface condition when blanking hot- and cold-rolled low-carbon steel is shown in Fig. 9.

Contrary to normal expectations, the presence of a radius in place of the normal sharp cutting edge of the blanking die has little effect on the blanking load. The variation in blanking load with die radius for hot- and cold-rolled low-carbon steel is shown in Fig. 10 (*a*); the variation in stripping force with die radius is shown in Fig. 10 (*b*).

The concavity present in the top surface of the blanks was termed "dishing." This was measured on blanks 0.160 in. thick in the hot- and cold-rolled material for each die radius used. The results are shown in Fig. 11 (*a*). Up to 0.20-in. die radius, dishing of both hot- and cold-rolled material was small but thereafter increased steadily with increasing die radius.

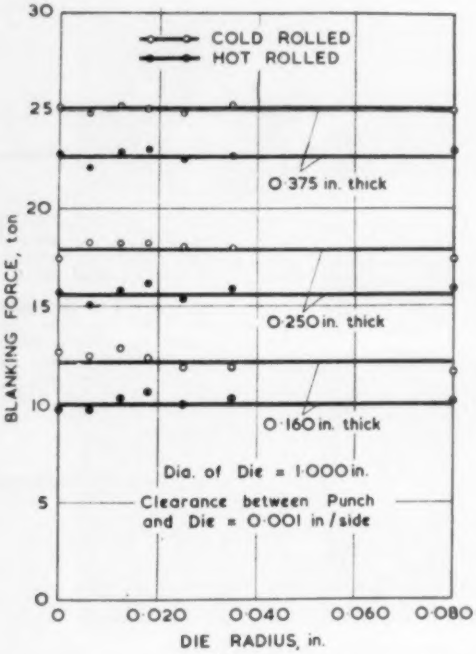
The taper on the side of 0.375-in. thick blanks was of the order of 0.002 in. and appeared to be relatively unaffected by changes in die radius (*see* Fig. 11 (*b*)).

One of the "penalties" of finish blanking is that there is a tendency for slight burrs to be formed both on the blank and on the underside of the stock. However, these are generally easy to remove by normal de-burring methods. An indication of the burr heights formed on low-carbon steel is given in Fig. 12.

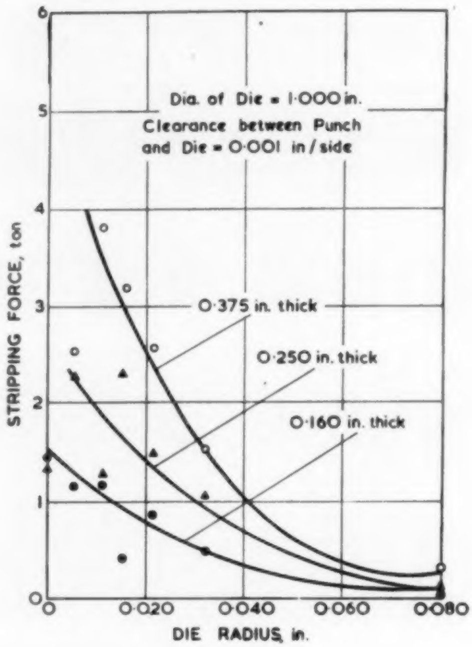
DESIGN, CONSTRUCTION AND USE OF FINISH BLANKING TOOLS

Tool Design

As mentioned earlier in the paper, the amount of radius required on the edge of finish blanking dies varies according to the type of material, material temper, thickness and profile of the com-



(a) *Blanking force*



(b) *Stripping force*

Fig. 10.—Effect of die radius on blanking and stripping forces.

ponent. For a given set of conditions, increases in die radius beyond the minimum value required for good results have no further effect on the condition of the sheared surface, but merely tend to increase the distortion of the component and increase burr formation on the underside of the stock. It is, therefore, important to use the minimum radius that will give good results. In general, the required radius can vary from 0.010 to 0.080 in. according to circumstances.

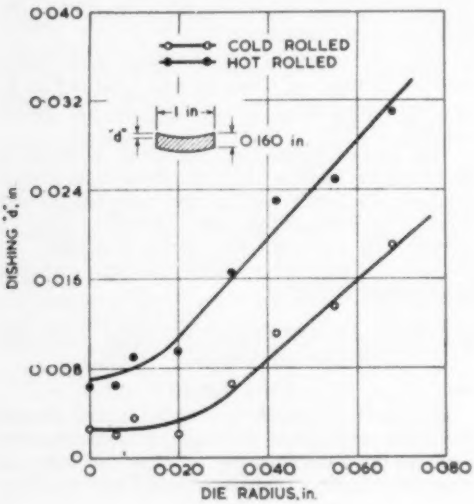
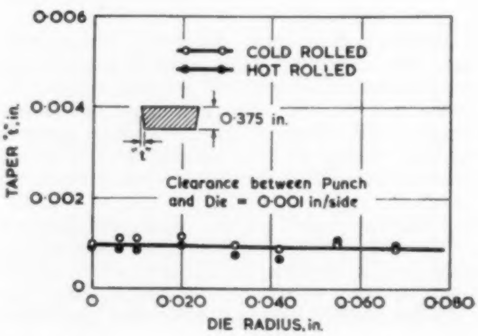


Fig. 11.—Effect of die radius on distortion of blank (a) (left) Dishing; (b) (right) Taper



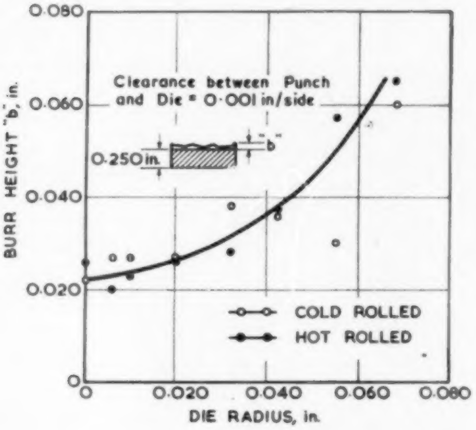
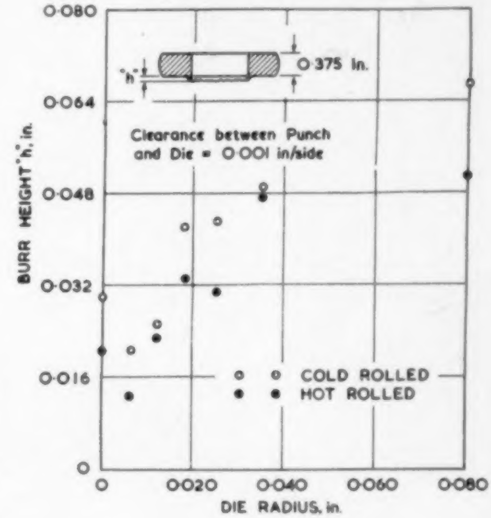


Fig. 12.—*Effect of die radius on burr height.* (*a*) (*above*) *on blank;* (*b*) (*right*) *on underside of material stock*



When finish blanking components of irregular profile, it is sometimes advantageous to vary the die radius according to the profile. This applies particularly to sections of very small radius, sharp projections, notches, etc. In such cases, there is a tendency for loss of metal thickness due to dragging of the material during blanking, but this can be minimized by the use of a smaller radius (up to 50 per cent) than that required for the remainder of the component profile. It is, of course, essential for the smaller radius to be smoothly blended into the larger radius along the die profile.

Although the load required for finish blanking is no more than 10 per cent greater than the load required for conventional blanking, there is a much greater radial or bursting load on the die which should be designed accordingly. The radius should be smoothly blended into the die face and bore, and should be followed by a parallel throat to a depth of 100 per cent to 200 per cent of the material thickness ; this can then be followed by a taper relief of 1 to 2 deg. per side. It is advisable to specify a heavy-duty die material such as, for example, one of the high-carbon, high-chromium types.

Punches for use with finish blanking dies should be well supported in order to ensure that they do not deflect or distort during the blanking operation. A sharp cutting edge is required and, as with finish blanking dies, it is advisable to specify a heavy-duty tool steel.

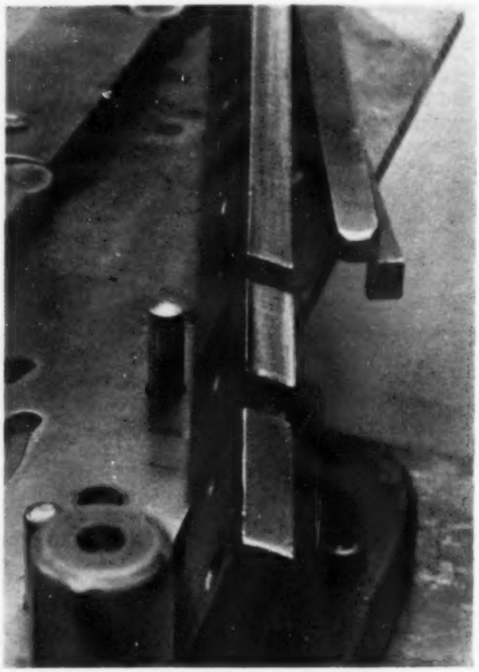
The clearance required for finish blanking is very much smaller than for conventional blanking operations and is generally not dependent upon the material thickness. With most materials and thicknesses, a total clearance of 0.0005 to 0.001 in. will give satisfactory results. Only in very rare cases will a larger clearance than this be satisfactory and it is always advisable to keep the clearance as small as practically possible. An increase in clearance beyond the figures quoted will result in cracking or tearing of the upper portion of the sheared surface, irrespective of what die radius may have been used and it is, therefore, important that the clearance should be uniform at all points.

Due mainly to the very small punch and die clearance which is involved, the stripping force during finish blanking operations is much greater than in conventional blanking and may, in some cases, be as much as 10 per cent of the blanking load. Consequently, the stripper should be of robust design and of the gap type in preference to the pressure-pad type. When deciding upon the amount of gap to be left between the top of the die and the underside of the stripper, allowance should be made for the formation of a burr on the underside of the stock (*see* Fig. 12).

Allowance should also be made in the strip guides for the lateral distortion of the strip that takes place during finish blanking. This lateral expansion is caused by the radial flow of metal from the blank into the material stock. As an example of this it was noticed during some tests at PERA that $1\frac{3}{4}$-in. by $\frac{3}{16}$-in. cold-rolled mild-steel strip increased in width by as much as 0.050 in. If rigid strip guides are used with insufficient clearance for this expansion, the material stock will distort towards the end of the operation, causing the pierced hole

Fig. 13 (left).—Flaking of punch due to insufficient strip guide clearance

Fig. 14 (below).—Worn strip guide caused by distortion of material during finish blanking



to crowd on to the side of the punch thus considerably increasing the stripping force, and in some cases leading to flaking and fracturing of the punches as shown in Fig. 13. A further consequence of this is the deterioration of one or other of the strip guides as shown, for example, in Fig. 14.

If the clearance between the strip guides is too large, there will be insufficient control of the metal being fed to the tool which, with progressive or follow-on tools, may lead to faulty components. The most satisfactory solution is, therefore, to incorporate a spring-loaded pad into one of the strip guides adjacent to the blanking die which will then accommodate the distortion occurring during the operation and thus allow the remaining portion of the strip guides to effect the necessary control of the passage of material through the tool. A spring-loaded pad of this type that has been used successfully in practice is shown in Fig. 15.

Tool and Press Alignments

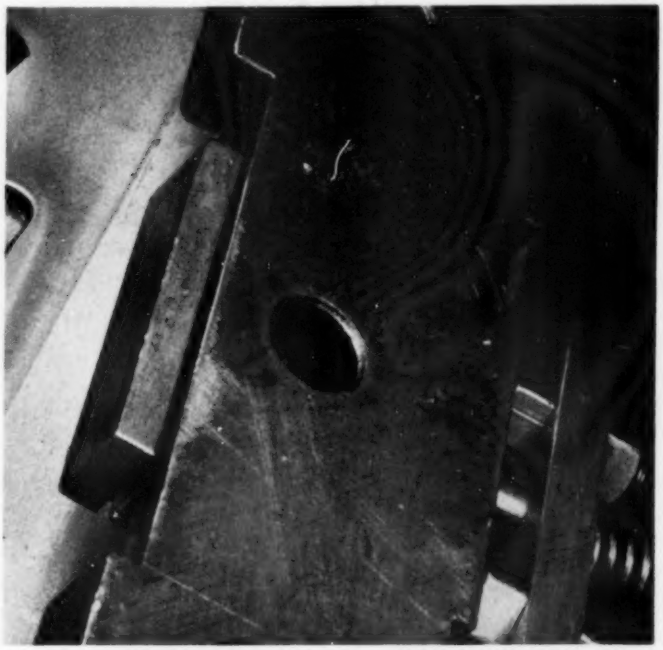
With punch and die clearances of the order of 5 to 10 per cent of the material thickness, as commonly used in industry for conventional blanking tools, small alignment errors can be permitted without damage to the tools, provided the strip thickness is relatively large. However, with finish blanking, it is vital to maintain a very small clearance between the punch and die throughout the whole of the operation if successful results and good tool life are to be obtained. This means that particular attention must be paid to the construction of the blanking tools.

It is often extremely difficult to introduce into industry a more economical technique which demands an improved standard of precision when older techniques have been employed satisfactorily for many years. The methods of tool manufacture previously employed often fail when applied to the new technique, and require some modification in design or in tool-making practice. This problem may usually be overcome by ensuring that all

Fig. 15 (right).—Spring-loaded pad incorporated in strip guide to accommodate distortion of material during finish blanking

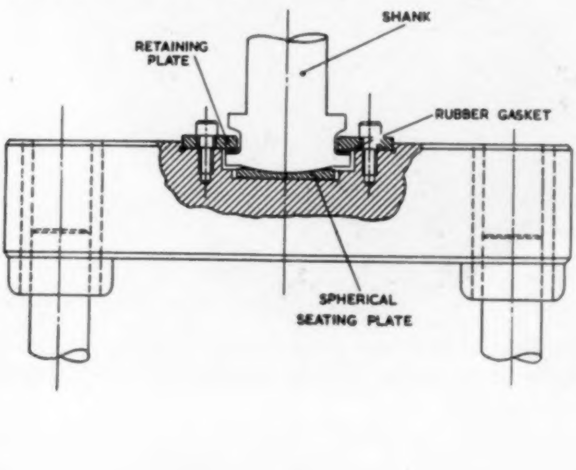
Fig. 16 (below, left).—Typical "semi-floating" coupling for connecting top of die-set to press ram

Fig. 17 (below, right).—Distortion of open-fronted press frame (exaggerated) during blanking



concerned understand completely the new requirements and are provided with adequate facilities for achieving them.

The first requirement in a finish blanking tool is for a robust and accurate die-set. Unlike many conventional blanking tools, the function of the finish blanking die-set is primarily to maintain good alignment between punch and die throughout the entire press stroke, instead of merely providing a rapid and convenient means of tool setting. Die-sets of the four-pillar type are particularly recommended, but if these are not available, a diagonal



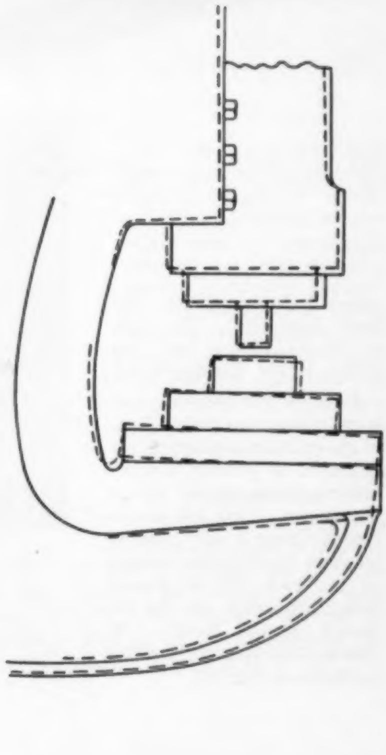


Fig. 18.—*Examples of finish blanking*

Fig. 18 (*a*) (*right*).—*Material* $\frac{3}{16}$*-in. thick low-carbon steel; die radius* 0.025 *in.; clearance* 0.0005 *in. per side*

Fig. 18 (*b*) (*below*).—*Material* $\frac{3}{16}$ *in. thick low carbon steel; die radius* 0.062 *in; clearance* 0.001 *in. per side*

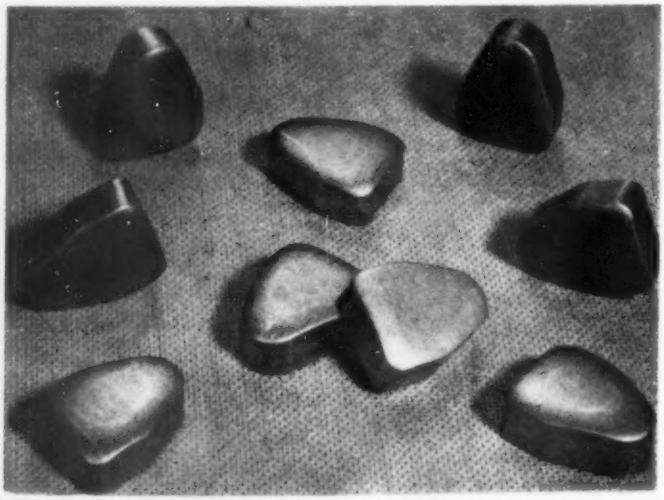
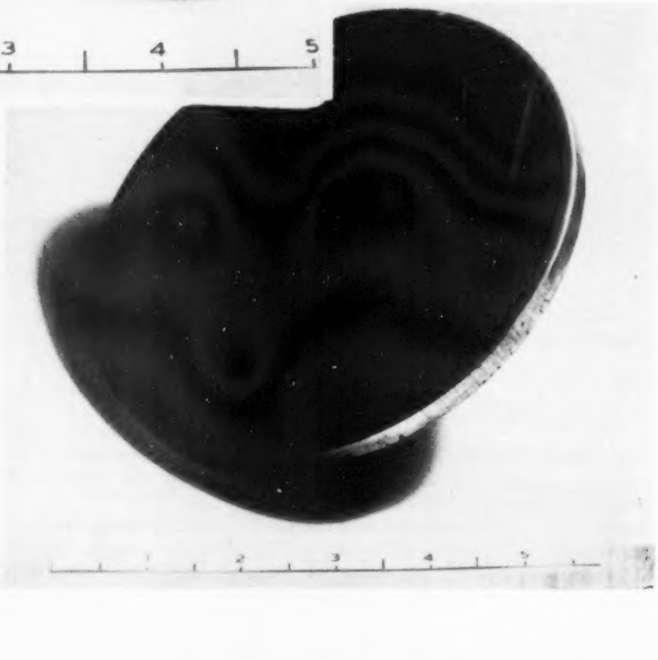


Fig. 18 (*c*) (*below*).—*Material* $\frac{5}{16}$*-in. thick low-carbon steel; die radius* 0.030 *in.; clearance* 0.0005 *in. per side*



two-pillar type is the next best alternative. The type of die-set having two rear pillars is not recommended.

If the finish blanking tool is to be used in a power press of the open-fronted type, it is desirable to provide a semi-floating shank to the top of the die-set. This will ensure that the press is only used to transmit reciprocating motion to the tool, the alignment being dependent on the accuracy of the die-set. A typical semi-floating coupling is shown in Fig. 16.

One of the most popular types of power press, the "C"-frame or open-fronted type, is unfortunately the least desirable type for finish blanking because of the angular deflection, or spring, of the frame that takes place when load is exerted. The effect of this, shown exaggerated in Fig. 17, is to deflect the punch laterally in relation to the die with subsequent damage to the tool and the likelihood of poor tool life. In some recent tests carried out at PERA on an open-fronted press, it was observed by means of high-speed photography that the punch was deflecting 0.016 in. relative to the die at the commencement of a blanking operation.

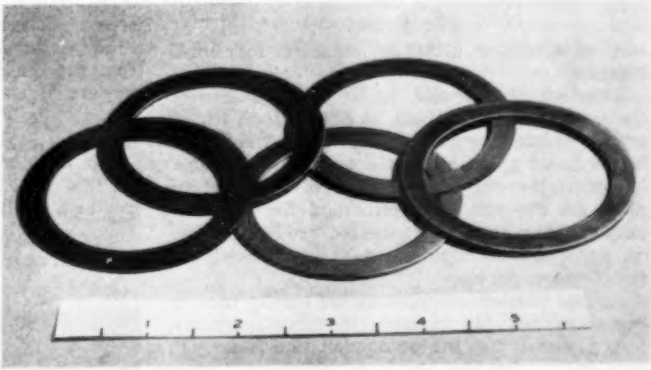
If, therefore, it is necessary to use a press of the "C"-frame type, one having the largest possible reserve of capacity should be selected and the tools should be provided with a semi-floating coupling of the type described previously. Ideally, however, finish blanking tools should be mounted in presses of the straight-sided type, since these deflect mainly in the vertical plane and hence have little effect on the alignment of the punch and die.

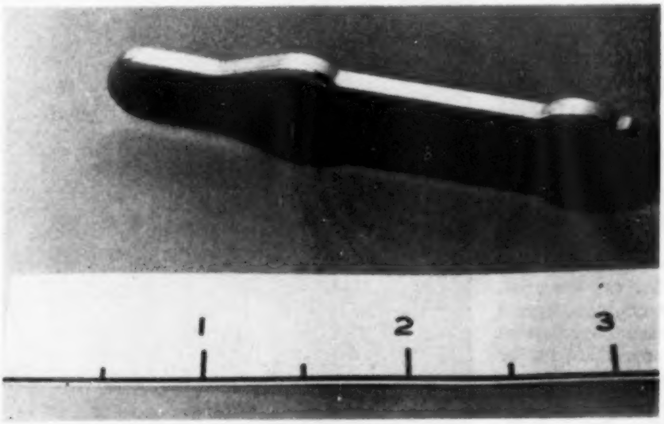
Fig. 19.—Examples of finish blanking

Fig. 19 (a) (above).—Material $\frac{1}{8}$-in. thick En 25 steel; die radius 0.015 in.; clearance 0.00025 in. per side

Fig. 19 (b) (right).—Material $\frac{1}{32}$-in. thick steel, copper and brass; die radius 0.010 in.; clearance 0.00025 in. per side

Fig. 19 (c) (below).—Material $\frac{3}{32}$-in. thick brass; die radius 0.015 in.; clearance 0.0005 in. per side





Lubrication

The finish blanking of non-ferrous material does not usually present any serious lubricational problems but it is good practice to lubricate both sides of the material with a low viscosity mineral oil before blanking. Pick-up of the materials on the

(*Continued in page* 354)

In striving for good tool alignment during finish blanking operations, it is sometimes overlooked that every power press is an elastic structure which will deflect in some manner when load is being exerted on the tools.

FINISH BLANKING—2

By RÉNÉ HAAG*

(A paper presented at the Annual Conference of the Institute of Sheet Metal Engineering, London, November 1959)

MANY experiments have been carried out over the past five years on fine blanking, the idea always being to produce blanked components having a square cut edge with a clean sheared surface finish, instead of the usual broken finish. To produce fine blanked components, the two most important factors are the press and the tool.

The Press

A triple-action press is necessary for finish blanking.

The best performance, so far as the quality of the parts is concerned can be obtained on triple-action hydraulic presses where components can be produced up to a material thickness of 6 mm. However, the big disadvantages of this type of press are the very high price and the very low output. The maximum possible production rate on the hydraulic triple-action press is about 400 to 600 pieces per hour.

As fine blanked components are mostly used in big quantities, for example in office machines, it is essential that the production rate is as high as possible. For this reason a single-action toggle press was chosen and the two additional actions added in the form of spring pressure pads. The fine blanking press shown in Fig. 1, produced by the Essa Machine Manufacturing Ltd., in Brugg, near Bienne (Switzerland), is a single-action toggle press of 60 tons capacity with a built-in pressure pad of 10 tons in the head of the press, and one of 10 tons in the bottom of the machine. A press of 120 tons of similar design but with pressure pads of 20 tons each is also produced and machines with 250 tons total pressure are now being constructed.

The 60-ton press can produce up to 70 pieces per minute from automatically fed coil material. The maximum speed is not governed by the press but only by the ability of the material to be sheared properly. The maximum thickness that can be fine blanked on the 60-ton press is about 0.080 in., as it is not possible to incorporate stronger pressure pads, and about 0.120 in. on the 120-ton press. The maximum thickness may vary depending on the material to be blanked.

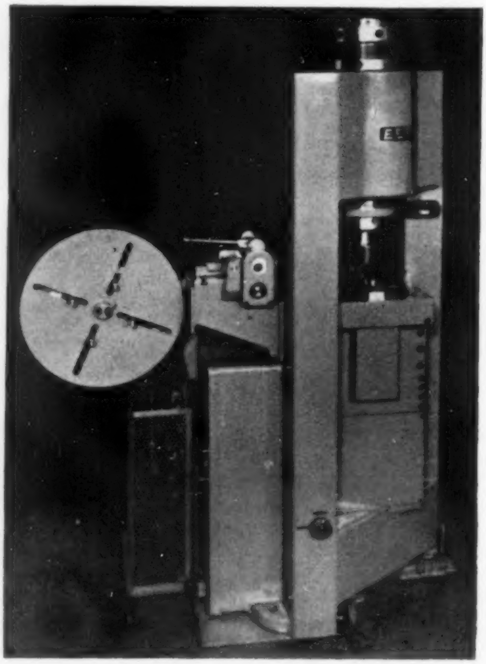
Besides the two pressure pads, a supplementary device is required to delay the action of the lower pressure pad. If this is not controlled, spring pressure would push the blank back into the strip, destroying the good surface finish of the fine blanked component as well as complicating the collection of the parts. In the press, shown in Fig. 1, this delay device is hydraulically operated and holds the lower spring pressure pad in its lowest position until the component is positively ejected. The blanks are then blown out of the tool if they are small and light, or removed mechanically from the die surface by a special attachment if they are large and heavy.

The Tools

The tools have, of course, to be specially made for fine blanking. The material must be held around the punch by means of a knife-edged ring

Fig. 1.—*Fine blanking press*

(Courtesy of Essa A. G.)



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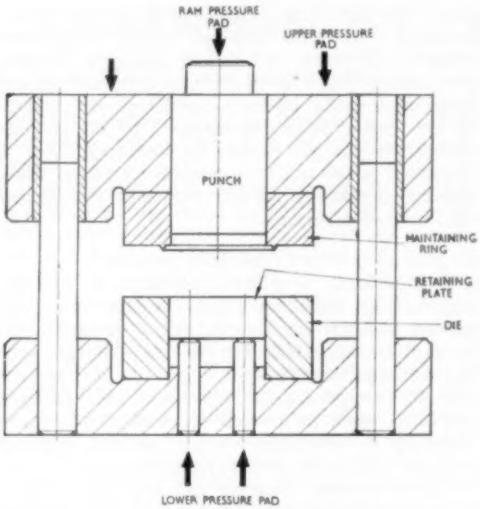


Fig. 2.—Fine blanking tool set

on the pressure pad, in order to keep the material from moving under the action of the punch and the component is held from underneath while it is blanked, in order to prevent the parts being distorted or projected by the blanking action.

Fig. 2 shows a fine blanking tool set. A very accurate pillar die set has to be used especially as there is no clearance between the punch and the die. The die must be built in segments and both this and the punch must be profile ground. High-carbon/high-chrome steel should be used for punch and die or even better tungsten carbide, which should always be considered for high production. The pressure pads can be made in both cases of high-carbon/high-chrome steel. The knife-edged ring is milled and does not need any maintenance. Generally a fine blanking tool is of the compound type, but if the component has to be coined or slightly bent, it is also possible under certain circumstances to produce it in a progressive compound fine blanking tool. In this case the coining, preblanking and bending would be done in the first and/or second stage and the fine blanking in the final stage.

The accuracy of fine blanked parts is much higher than normally obtained with standard blanking. Tolerances of 0.0004 in. can be maintained easily. Furthermore, it is possible to pierce holes which are half the thickness of the material in diameter, without any risk of breaking the punches when they are drawn back after piercing. It is, in fact, possible to introduce the piercing punch into the pierced hole, and this can never be done with standard blanking tools. The tool life of fine blanking tools is identical to standard compound tools and the price of manufacturing is about 25 per cent higher than ground compound tools. Maintenance costs can be compared with compound tools.

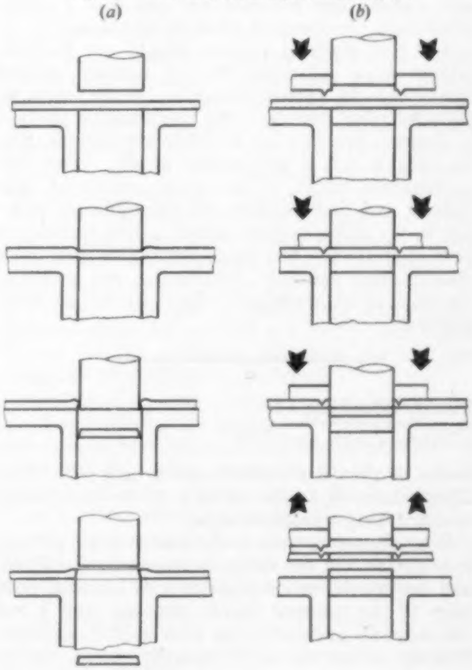
The Process

With standard blanking the material is not really sheared, but broken; only about one-third of the thickness is cut, although this varies slightly depending on the tensile strength of the material. The ordinary blanking process is shown in the left column of Fig. 3, while the right column shows the fine blanking process. When blanking normally, the punch penetrates the material, spreading it all around the punch, until the elastic limit of the material is reached. Only then is the metal sheared or broken, giving a very poor surface finish and the spread material goes back into its previous position as soon as the punch is retracted. The pressure around the punch is, therefore, very great and can break it if the punch diameter is less than the metal thickness.

The fine blanking process can be explained as follows :—

When the ram moves downwards, the strip of material between the matrix or die and the guide plate is held under the pressure of springs compressed 5 to 10 mm. The knife-edged ring of

Fig. 3.—Ordinary (a) and fine blanking (b)



Finish Blanking—2

(*Continued from page* 353)

the guide plate and the lower ejector—which is subject to the same pressure *via* pressure pins—penetrate into and compress the material, displacing it.

As the punch enters the material on completion of the down stroke, the cutting process is such that the blanked part is always compressed between the punch and lower ejector (to prevent spreading or tearing); as the material has already been displaced by the knife-edged ring, the normal break away at the blank's periphery is avoided.

When the ram is moved back the blanked parts as well as the piercings are pushed out by means of the ejectors and here it is essential that the lower ejector should operate with a delayed action so that the blanked parts, etc., cannot be pushed back into the strip.

Material

As the fine blanking technique is comparatively new, the most suitable qualities of material are not definitely established. Generally speaking, non-ferrous metals and rolled steel up to 0.3 per cent carbon content give good results.

A surface finish of 20 to 30 micro-inches can be obtained without difficulty and the cut surfaces will always be square and parallel. Over 0.3 per cent carbon, fine blanking will not give a better result than the standing blanking technique.

The fine blanking process should not be considered as a substitute for the normal shaving technique. In certain instances, as for example parts for office machines, the fine blanking method is cheaper, but in a lot of other applications, fine blanking is not a proposition at all. From the experiments made, it has been concluded that shaving and fine blanking are two different techniques for different applications. Both techniques have their virtues, but their applications have to be chosen after carefully considering the material, the shape of the workpieces, the finish and accuracy required.

Finish Blanking—1

(*Continued from page* 351)

radius of the die is seldom serious and fairly little deterioration in surface quality of the component occurs during a production run.

With ferrous materials, the tendency for pick-up to occur on the die radius is much more marked, and the recommended practice is to lubricate both sides of the material before blanking with a low viscosity oil, preferably one with an E.P. additive. Pick-up on the die radius usually occurs rapidly after production of the first two or three components, causing some axial scoring of the component surface. However, the pick-up does not increase continuously but appears to break away and reform again in a cyclic manner. Although the quality of the sheared surface is impaired by the pick-up present on the die radius, the resulting finish is generally equal to, or sometimes superior than, shaving operations carried out as a subsequent operation to blanking.

Tool Life

It is difficult to obtain authenticated tool life figures from industrial finish blanking tools, but reports indicate that the tool life is at least equal to and sometimes superior to that obtained from conventional blanking tools. One company regards 100,000 components as the usual life between regrinds, while in another instance of the finish blanking of steel, the die life between regrinds was reported to be 220,000 components.

When a finish blanking punch is reground to restore the sharp cutting edge, it is usual for the die radius to be lightly stoned to remove any pick-up or scratches. Complete regrinding of the die, including the radius, is usually necessary at much less frequent intervals than the need for punch regrinding.

It is important to ensure that tool grinding personnel are aware that the finish blanking tool has been deliberately provided with a radius in the first instance. Some firms who initially failed to make this point clear to all concerned, discovered that finish blanking dies were being reground to a sharp cutting edge, the original die radius being mistaken for excessive wear.

Examples of Finish Blanking

Figs. 18 and 19 are a few of the large number of components now being produced in industry by finish blanking. These have been included in the paper to indicate the variety of components to which the process can be applied. Details are given of each component, in so far as they are known, in order that they may be used as a guide to values of die radius when the application of finish blanking to a component of similar material and size is being considered.

Acknowledgements

The author wishes to thank the Director and Council of the Production Engineering Research Association for permission to publish this paper, and also various colleagues for assistance with the experimental work.

Reference

1. "Recent Investigations into the Blanking and Piercing of Sheet Materials." Tilsley, R., and Howard, F. Conference on Technology of Engineering Manufacture, Paper 16—1958, Institution of Mechanical Engineers.

DISCUSSION ON "FINISH BLANKING"

Mr. McKIE (National Cash Register Co. Ltd.) asked Mr. Howard how he overcame pick-up, which invariably obtained in the process. Did he add a lubricant to the tool, or did he have a special tool ?

Mr. HOWARD said that it was normal to use an E.P. oil, but it was rather difficult to get the lubricant to the zone of shear. Inevitably there was a certain amount of pick-up with finish blanking early in the operation. It had so far been his experience—and the experience of many member-firms of P.E.R.A.—that pick-up did not get too serious and did not build up continuously. It appeared to build up to a certain extent and then to break away and then re-form again and break away in a cyclic manner. He had not heard, so far, of any case where there were any serious pick-up troubles, which were often experienced with steel.

Mr. NUTTING (Wilmot Breedon Ltd) asked whether Mr. Howard could tell him whether there had to be any variation in tool design when blanking various quality steels.

Mr. HOWARD said that he would not expect any difference in basic tool design, but differences in the radius might be required depending on the profile and thickness of the component.

Dr. H. T. COUPLAND (Rubery Owen & Co. Ltd.) asked Mr. Howard what accuracy of die radius was required in the finish-blanking technique and how accurate was the best method of producing it.

Mr. HOWARD replied that the accuracy of the die radius very much depended on the component and the amount of the die radius required. In certain cases, notably non-ferrous materials, quite a small radius was required, *i.e.* about 0.010 to 0.015 in. If that were the case, it was required to produce the radius to an accuracy of ± 0.002 in. In the case of a large steel component, the die radius might be as large as 0.030 in. or, in some cases, even greater. In those circumstances, the tolerance could possibly be ± 0.005 in.

Industrial experience so far had shown that, in fact, there was not a great deal of difficulty in putting radii on the dies. Normal practice seemed to be to use a small abrasive point to cut the tool fairly near to what was required and then to finish off with a slipstone.

Mr. H. J. RISELEY (Projectile and Engineering Co. Ltd.) said that in a typical finish-blanking operation, such as that described by Mr. Howard in his paper, it might be that there would be a contour, such as the speaker had in mind, of about $\frac{7}{16}$ in. thick and about 6 in. long, in the form of a boomerang, but with one end square. Obviously, the radius for the die could go right round, but at the junction where it was required to finish-blank square, a radius could not be put on. Would Mr. Howard recommend the same clearance to any radius or the normal, say 10 per cent clearance ?

Mr. HOWARD replied that he would recommend a very small clearance all round and the die radius to be feathered off to a sharp cutting edge adjacent to the square end of the component.

Mr. DAVIES (A.W.R.E.) asked what was the order of blanking speeds which Mr. Howard had used, or was that a function of thickness ?

Mr. HOWARD said that his work on finish blanking had been carried out at approx. 50 strokes per minute. So far as he was aware, there was no significant speed effect.

Wear Characteristics of Radiused Dies

Dr. J. F. WALLACE referred to Dr. Crasemann's* explanation of the causes of wear on blanking tools and pointed out that in his case, with the radiused die, slipping over the die itself was being encouraged. What were the wear characteristics of the radiused dies ?

Mr. HOWARD said that so far as could be ascertained wear characteristics were good. The process had now been used in industry for over five years but he very much regretted that it was not always easy to get reliable figures of wear from industry, because once something was working well, people in industry tended to forget it.

He knew, however, that the tool for one of the $\frac{3}{16}$-in. thick mild-steel components which he had shown when presenting his paper had an average life between reconditioning of about 100,000 components. After that time, the punch had to be re-ground and the die usually had to be re-polished. He had heard of a case which was even better than that and it was possible that this was one of the earliest examples of the finish blanking of steel which had been reported. The toolmaker in question had reported that since he had made the tool it had been back to him on four occasions, on each of which he ground the punch and lightly stoned the die. During this time, the tool had produced over 900,000 components.

Mr. McWILLIAMS (Projectile and Engineering Co. Ltd.) asked what clearance Mr. Howard would recommend between the blank and plate sides; in other words, what clearance would he allow around the plate contour when finish blanking. Second, could molybdenum disulphide be used ?

Mr. HOWARD said that he presumed that Mr. McWilliams was referring to the web thickness of the stock. That had to be somewhat greater than

* Dr. Crasemann's paper was published in the April, 1960 issue of SHEET METAL INDUSTRIES.

for normal blanking, because there was a pronounced radial flow of metal from the blank into the stock. In general, he would say that it had to be at least equal to the material thickness—sometimes dependent on the profile—and preferably a little more than that.

At that stage, he preferred not to comment too much on the use of molybdenum disulphide, as observations on the use of die lubricants had not been completed.

Mr. McWILLIAMS said that he had treated a tool by dipping it in molybdenum disulphide in a tank, with very favourable results; it might possibly work the same way with finish blanking.

A SPEAKER said that in the figures shown in Mr. Howard's paper, the author had frequently given a radius of about 10 per cent of the material thickness, other than where he could make it greater. Had Mr. Howard found that 10 per cent was a good figure with which to start as a ratio of radius to material thickness and for generally good radius and clearance ?

Mr. HOWARD said that it had not yet been possible to show any relationship between thickness of material and radius. He supposed that there was some relationship, but it was somewhat complicated by a number of other factors—the hardness of the material, the profile of the component part, and so on.

So far, all it had been possible to do was to give a series of recommendations, covering different thicknesses of material, which could be used as a general guide, but in each case member firms were told that they should regard those recommendations only as a basis and, if they did not get the desired results, should then locally increase the radius or make increases all the way round until the desired results were obtained.

This was a matter which it was hoped to be able completely to resolve in the future, but in the meantime the existing information had been given to members of P.E.R.A. so that they could use it without undue delay.

Mr. HOBBIS (Austin Motor Co. Ltd.) asked whether Mr. Howard had had any experience with the use of tungsten carbide in this process.

Mr. HOWARD said that he had not. In his investigations he had been concerned only with fairly short runs. Therefore, it had not been found necessary to employ carbides. It would be very satisfying to have a run of some length on which those materials could be used, but it was always extremely expensive and not always easy to make arrangements with commercial firms. So in the main the observations on the life of a punch, etc., had to come from member-firms who used the process themselves. He believed that one such firm was contemplating the use of carbides for finish blanking, but he had no direct evidence that they yet had any figures for it.

Dr. WALLACE asked what was the effect of a radiused punch, which would be cheaper to produce than a radiused die.

Mr. HOWARD said that the effect of a radiused punch was slightly to improve the condition of the hole, but to leave a poor finish on the outside of the blank. It had been originally hoped that this would be the way to obtain a good sheared hole, but another technique for producing good finish pierced holes had recently been discovered by P.E.R.A. This was the subject of a patent application and no further details could be given at the moment.

Dr. WALLACE said that he had heard that the Russians had been trying a technique whereby holes were punched using ultrasonic oscillation. This reduced pick-up and caused the metal to break down, preventing the build-up of flash. The punch in the process was in longitudinal oscillation. This was another application of vibration drawing.

Mr. H. RYALL (S. Smith and Sons (England) Ltd.) complimented Mr. Haag on his samples. He imagined that the position of the knife edge on the pressure ring had some relationship to the thickness of the material. Would Mr. Haag confirm that ? Was not the same true for the height of the knife edge, thereby giving a cross-section ? Similarly, a knife edge on that sort of plate must have a high manufacturing cost and high maintenance cost. He would appreciate information on tool steels suitable for the high pressures involved in the corners of the pressings.

Mr. HAAG said that Mr. Ryall's assumption about the height of the knife edge was correct. The height had to be about one-third of the material thickness and the distance from the punch had to be as small as possible, about 0.040 in., to keep it strong. The manufacturing cost of a fine blanking tool was about 25 per cent higher than a normal compound tool. There was practically no wear on the knife edge. Experience had shown that it was possible to make a tool which would produce 500,000 to 600,000 components without the knife edge having to be re-machined.

Mr. McKIE (National Cash Register Co. Ltd.) asked if he was correct in assuming from what Mr. Haag had said only a double-action die could be used.

Mr. HAAG said that double action was not enough; in fact three actions were needed. In a typical case there would be a knife-edged ring and there would be 10 tons in the head and 10 tons underneath the pressure pad. Thus, the two pressure pads formed additional actions, if he could call them that.

Mr. J. A. GRAINGER (Roneo Ltd.) said that he could see a similarity between the two methods of finish blanking. In that explained by Mr. Haag

(*Continued in page* 374)

"PRESSES AND PRESS-SHOP EQUIPMENT"

Report of a Discussion Forum Organized by the Midland Branch of the INSTITUTE OF SHEET METAL ENGINEERING

MEMBERS OF THE PANEL:

A. VALLANCE, ESQ. (*Hordern, Mason and Edwards Ltd.*), "*Presses.*"

G. B. CROSTHWAITE, ESQ. (*Managing Director, Bronx Engineering Co. Ltd.*), "*Press Brakes and Shearing Equipment.*"

F. EVANS, ESQ. (*Director, Press Equipment Ltd.*), "*Feeding Equipment.*"

K. R. C. MOORE, ESQ. (*J. P. Udal Ltd.*), "*Safety.*"

F. A. BATTY, ESQ. (*Head Wrightson Machine Co. Ltd.*), "*Roller and Flex Levelling.*"

CHAIRMAN:

T. W. ELKINGTON, ESQ., *Chairman of the Midland Branch, Institute of Sheet Metal Engineering.*

* * *

QUESTION: *What is the reason for the preponderance of American presses used in the new press-shop layouts in Britain at the present time?*

Mr. VALLANCE said that he thought it was not the fault of British designers but the fault of the users who bought them. Presses could be bought in Great Britain to suit the whole needs of the industry if it wanted them!

As regards transfer presses the buyers only had themselves to blame if there was no serious competition in this country for that type of machine, because there were manufacturers who could design and supply very good transfer presses. He knew one company, at least, which had nearly 100 years' experience of transfer presses behind it, and they could not get orders from British industry.

Mr. UDAL (J. P. Udal Ltd.) said that there were no American presses, as far as he knew, coming into this country. There were, however, many American-designed presses made in the U.K.

For a good many years after the war it was not possible, economically, to buy American presses, and arrangements were then made for manufacture in this country. As far as Continental presses were concerned, he thought the reason for the high cost was the very high sales content which had to be present in the cost.

The CHAIRMAN said it would be true to say that transfer presses from the Continent had been coming in to this country fairly frequently.

Specialized Presses

QUESTION: *Is the present tendency for presses to become more specialized in design going to increase in the future?*

Mr. VALLANCE replied that there were no specialized types of presses other than what might be described as the "maid-of-all-work" which industry had called for this last 10, 15 or 20 years, *i.e.*, the multi-"C"-type frame. This inclineable press had been "made" by the industry perhaps to the exclusion of other types and this had led manufacturers to specialize to a large extent on the multi-production "C"-frame presses and inclineables of that type. This was to the advantage of the users, because they got the advantage in a fairly reasonable price.

QUESTION: *Press brakes cause a tremendous amount of trouble in industry owing to the short stroke and safety, and the two could not tie together. Why were they not made with a longer stroke? If they can be made but at increased cost is this one of the reasons for their non-manufacture?*

Mr. CROSTHWAITE said it was possible to have a press brake with any length of stroke provided the user was prepared to pay for it! The vast amount of work called for from a press brake varied with the size of the machine and a stroke of 2½ to 3 in. up to 4½ to 6 in. usually covered 95 per cent of the requirements of a mechanical press brake. Above 6 in. the machine would have to be specially built because the demand from industry was not great. As regards hydraulic machines, however, it was possible to have a very long stroke dependent upon the application called for, and possibly this type of machine would meet the questioner's requirements.

QUESTION: *Would the panel agree that 80 per cent of the brake presses made were about 3-in. stroke?*

Mr. CROSTHWAITE replied that in his opinion 80 per cent had a 3-in. stroke, another 15 per cent a 4½-in. stroke. The other 5 per cent, possibly less, were called for with a stroke of 6 in.

The CHAIRMAN asked whether the guard hampered the stroke, *i.e.*, was the question anything to do with safety?

Mr. CROSTHWAITE said that a long stroke machine was required for producing, for example, roof decking, and the like, where a type of corrugation having a depth of 4½ in. was made. The tool had to be able to lift sufficiently to allow the decking profile to be withdrawn and put forward for the next operation.

Mr. MOORE (J. P. Udal Ltd.) said that he thought the question referred to the fact that with the present short stroke on press brakes of 3 in., or a little more, the guard manufacturers were, more or less, forced to put some form of interlock guard on the machine. The regulations laid down in 1945 stated: "No machine shall be worked with a stroke of less than 5 in. with an automatic guard." He thought the questioner considered that with longer strokes automatic guards could be used, thus safeguarding the press more easily.

Brakes on Press Brakes

Mr. FERNDALE (I.G.E.) suggested that the press brake manufacturers could make a larger contribution towards safety if they fitted far more efficient brakes to the machines. The actual existing method of fitting an ordinary hand brake on a machine which was inched, and stopped and started quite a lot during its stroke, did leave a lot to be desired. The maker had to fit an interlock guard and the efficiency of the brake was absolutely essential.

QUESTION: *The extent of automation adopted in the press shop is governed economically by the volume of production. Is automatic loading a practical proposition in a shop on batch work. If so, what devices are there to load various blanks (sizes and shapes) into different tools set up in the same press for short-run work?*

Mr. EVANS replied that the question could be divided into two parts. The first "Is automation a practical thing in the normal press shop?" Then, second, "If so, what devices are obtainable?" The first part depended on the economics of the press shop, and a useful yardstick was probably to assess first the time it would take to set up the particular job for hand-feeding, and the amount of time the operator would take to perform that particular job. If the setting time was roughly 10 per cent of the operating time, that was the point where automatic feeding could be considered. As regards the next part of the question, during the last 10 years there had been great strides in this field, and it was first necessary to think of the types of material to be fed. Was it to be coil from stock? Was it to be components that were already part formed? Was it to be blanks of substantial size, or substantially heavy and large-sized components? There were devices for handling all those particular types of materials in those forms, both for loading and unloading. This was said in a separate sense, and also where they were automatically loaded and taken away, and they ranged from feeding small power presses of 6 tons, up to the large presses for taking out large sheets and formed components. The savings given by the use of these was related to the first part of the question, and it was the feeding of one particular type, and the examination of the saving, balancing setting time out against the operating time, that dictated the particular type of device required.

As regards safety, there were strict regulations laid down for the guarding of power presses, and when presses were fitted with mechanical devices for feeding and unloading a lot of the hazards disappeared, but there were some left. The problem that confronted the designer was to try and avoid cluttering up the press with too much safety gear and too much automatic gear; in fact, there were problems of even getting both to work at once. Some relaxation of the regulations had been asked for, because they were framed for non-automatic machines. Up to the moment no success in this matter had been obtained.

Answering a question on cost of automation equipment, Mr. Evans said that the basis of all applications of automatic devices was the setting of the tools and again economics ruled. Often it was found that by the re-designing of the making of new tools that it was economically sound, and it permitted the use of the automatic devices. There were devices which allowed the use of existing tools, and as a direct estimate he would say that 50 per cent of tools with small modifications to strippers and guideways could be used with automatic feeding equipment. The other 50 per cent, generally, needed new tools or a complete rebuilding of existing tools.

QUESTION: *The machine-tool industry covers a very wide range, both from the machine-shop point of view, the press shops and all the other shops. Recently there has been an announcement given in some of the papers that an American, by the name of Melman, has visited this country and his report is to be very adverse towards the press-tool industry. Would the panel give an opinion on this matter and state what ideas they had for progress. A quotation from the report was: "The Western tool industry is technically backward, negligent of research and in danger of being dispelled from world markets by Soviet competition."*

The CHAIRMAN replied that the report appeared to refer to automation. Reading the reports that came from the Soviet, and other countries, on the machine-tool industry, he would think they had got something to say and Melman was right to a certain degree. In this country we had been a little slow in using automation in the machine shop. The problem of British press shops was that for many years it had not been necessary to reach the high

mass production level of the U.S.A. But on presswork we were now possibly in advance of the States on that particular line. If it was found that production had to be automatic, the manufacturers would turn round and supply automation.

Production on Small Presses

Mr. Moore thought that the Americans could not reach us on production of small presses. He thought they used much automation because their press operators were not as good as ours on small presses. In one press shop he was in recently operators on small presses were turning out 130 gross of articles a day.

Mr. Cadman (Fisher and Ludlow Ltd.) said that the British machine-tool industry, including the press-tool industry, had to contend with old-fashioned regulations and bureaucratic inspectors who did everything to stop progress. What counter-measures were being taken to deal with this rather unfortunate state of affairs?

The Chairman replied that he had had a letter from the Board of Trade, asking if he would accept certain regulations for the guarding of milling machines in the tool room. These regulations suggested that tool makers had to stand about three yards away from the machine! There had been hardly any accidents on milling machines, however.

Levelling

Question: *What are the advantages, or disadvantages, of roller and flex levelling?*

Mr. Batty (Head Wrightson Machine Co. Ltd.) said that first of all it was necessary to clarify what was meant by "levelling and flex levelling," which were really two different jobs. In one, material was being processed and in the other levelled. For levelling, obviously a roller leveller was required to get a flat sheet. In "processing" the material was worked before pressing to avoid the formation of stretcher strains, and a process leveller was required although the sheet was not required to come out particularly flat, and "levelling" was the wrong term to use.

The Chairman asked "How much did flex levelling really cut out annealing, etc., in deep drawing?"

Mr. Batty said that there had been very learned papers written on this subject, and it was still being investigated in great detail. Deep-drawing-quality sheet was nearly always skin-passed before use but by the time it reached the car-body works and had been lying about in store for a time, it aged, then stretcher-strain lines formed during pressing. There were two ways of curing this; one was either to skin-pass material again, the other to put it through a processer leveller. The processer leveller generally would take care of all but the worst cases. If the sheet had been in store for, say a year, and initially it had only a very light skin pass, then it was doubtful if stretcher strain could be avoided. For pressings where there were very shallow but difficult drawing operations as much processing as could be obtained was required, and even with a flex-rolling machine it was not always possible to avoid stretcher strains. There had been investigations going on into the use of different percentages of temper passing up to as high as probably 3 or 4 per cent. That would improve the material from the stretcher-strain point of view but it might not produce a material in the best condition for deep drawing. So it was necessary to define what was required of the material, skin passing to the biggest percentage possible conducive to a good pressing, and then doing some further processer levelling immediately before the operation. The second problem was when it was necessary to rely on processing at the factory; in this case there was always quite a portion of the sheet—at the beginning and end of the sheet—which was not processed, and if that happened to fall into part of the pressing then trouble could arise. His feeling was that with modern methods of automation and the use of more and more coil, the use of a processer leveller in the cut-up line at a factory where the pressing was being made offered the best solution. On the question of processers, there were two types. One had a flexing roller and the other was a modification of the standard leveller. The modified leveller gave probably 90 per cent of the processing obtainable on a flex roller machine, with the advantage that processing was effected nearer to each end of the sheet. With a very difficult pressing it might be necessary to use the flexing roller machine to get the best results and chance a little difficulty at either end. For a complicated pressing, then the standard leveller without a flexing roller would probably give the best result. It was possible to programme pressing so that coil processed in the actual cut-up could be used which was then fed on to the press, or it could be used to feed straight through into a blanking press.

Question: *In the past guards seem to have been added to presses as an afterthought. How much co-operation is there now between the guard manufacturers and the press makers?*

Mr. Moore said that the great majority of the guards had been added as an afterthought, and guard makers were sorry that this was so. There was a great deal of co-operation from the press makers, but there was room for more.

Mr. Johnson (Allen and Co.) said he was convinced that modern presses now cost nearly as much to guard as the cost of the machine itself. He would like the view of the panel on the advantage of a modern press, with the air-operated solenoid control clutch, as against the traditional key clutch.

Mr. MOORE referring to the cost of guarding presses, said that the guard manufacturers were restricted in what they could do in regard to press-guard designs, by specifications. Certain hazards that were known and arose from time to time in installations had to be covered. The guarding of an electro-pneumatic clutch press with an interlock guard was a more difficult proposition from the point of view of giving complete safety than it was with the key clutch. Manufacturers were not worried about the long-stroke presses fitted with an automatic guard, as the record of long-stroke presses with friction clutches was relatively good ; also the price was relatively cheap in regard to the press. With friction clutches the guarding was very difficult and more complicated to give a complete safeguard. As regards the cost of the guard, the more complicated the guard the greater the cost.

Safety Committee Report

QUESTION : *Would the members of the panel care to comment on the recent weighty comments of the Joint Safety Committee regarding the use and guarding of pneumatic clutches.*

Mr. MOORE replied that the great hazard when guarding a friction clutch machine was that it was very easy to start a press with an electro-pneumatic clutch but not so easy to stop it. There seemed great difficulty in getting rid of the air quickly enough to get reliable stopping, even reliable stopping in the same place. When it was necessary, for example on a high-speed press, to put interlock guards on, the great hazard was that the press must not make a stroke with the guard open, and that was the difficulty with pneumatic friction clutches, the unreliable stopping of the press, not the starting. If press makers could guarantee to stop the presses reliably they could be guarded simply.

Mr. VALLANCE said that he had never had any difficulty in stopping a press he designed at the particular spot where it should stop.

Mr. ROCKDEN speaking as a member of the Committee in question, said they were not only concerned with the machines not stopping but also with them starting when no one was near them ! He personally knew of one case of a press starting up with nobody at the controls and taking a man's hand off. The valve was a solenoid type.

The CHAIRMAN said that many of the breakdowns were electrical and that quality of the electrical equipment could still be improved.

Spares for Presses

QUESTION : *Why should spares take so long to be delivered from the manufacturers ? The onus, at present, seems to be on the user to order spares in advance of his requirements. As press breakages cannot always be foreseen and an idle press is a liability to a firm, this is not a satisfactory condition. If the range of presses offered is too wide for the press manufacturers to keep spares in stock, couldn't the press range be streamlined or more interchangeability of major parts be considered ?*

Mr. VALLANCE thought that it would be fair to say that the average top-class manufacturer, making, for example, the inclineable press, was in a position to supply spares very promptly. Designs were not varied unduly, and the net result was the constant manufacture of these units right throughout the works with spares units almost on call. There might be certain manufacturers who were not quite so well positioned as that, but the average good-class manufacturer would supply, for example, a spare crankshaft quickly. A longer time was required if the component had to be made specially and this was usually the case with fairly large sized presses.

QUESTION : *At what age should a press still have spares available for it ?*

Mr. VALLANCE replied that if a press was very old there was a difficulty over spares.

Mr. ROCKDEN said that anyone who sold something should be prepared to carry spares, and he saw no reason why a manufacturer should not make spares and keep them in stock. He thought that this was one of the reasons why foreign competition was a problem to the British press manufacturer. It was the same with a motor-car. Everyone was buying foreign motor-cars because spares could be obtained quickly.

The CHAIRMAN said he thought that certain firms were streamlining their production programmes and checking up on all that sort of thing. That was a good sign, but with a special job where perhaps only three a year were made it must be expected that there would not be freely available spares.

QUESTION : *What safety factor is there for overloading a press brake ?*

Mr. CROSTHWAITE, referring to mechanical press brakes, said there were a number of ways of safeguarding them from being overloaded. A breaker block in the ball end of the screws was one method. With a 100-ton machine, the brake was rated at 120 tons, and a shear-pin mechanism with the same safety factor could be provided, and the question of the clutch slipping did not come into it at all, because if the clutch slipped it would not do its work. Press-brake manufacturers could, and did, provide these safety devices and the first thing the user did on a 100-ton machine was to put 200 tons on it, and all the safety factors had gone. Most of the mechanical press brakes in use today did not have any overload device whatsoever, primarily because if they did the machines would be broken down for about two-thirds of their working time. One of the problems was that the

action of a crank press was such that it produced a very high load at the bottom of the stroke which was perhaps two or three times in excess of the normal capacity of the machine. That, in itself, almost from the start, precluded intelligent appreciation of how it was possible to provide a safety "valve" for a press brake. Hydraulic press brakes, of course, were another matter; they could not be overloaded.

QUESTION: *In considering automatic feeding, if operators only have to be used to operate emergency stops when things go wrong, is it a good thing to give them also some physical work to do?*

Mr. EVANS said that it was a good thing to give an operator, or "machine minder," a job to do while the pressing operations were taking place. In most devices there were safety means and systems built in to check if anything was going wrong as regards defects that could be forecast by the designer. But there were other things that could creep in while the process was taking place which might call for urgent action by the operator. Therefore, he should be adjacent to the machine, alert, and encouraged to watch the tools and the processing. An expensive piece of transfer equipment in an expensive press could work for weeks without fault, and then due to a mechanical failure of some description that the designer could not possibly cater for, the equipment could go wrong, and then if the operator was not alert he was not in a position to save perhaps many thousands of pounds. If he could be encouraged, if only to lubricate blanks, or swill suds, or operations of that description, and be properly directed as to how to stop the mechanism immediately, he was well employed.

Mr. BATTY, referring back to processing, etc., of material before pressing, said that further improvements in processing were possible and equipment could be located in or adjacent to the press shop. Research had been going on into a type of unit, which would in effect skin pass or temper roll, of a very different design to the one known at present; it could actually be sited in the press shop. The new unit would be a rather expensive item and could not be used so elaborately as the present processer leveller; it would have probably to serve the whole of the press shop but by the fact that it would give better results than the processer leveller it could be used more effectively. Processer levellers, while not cheap, were cheaper than a small temper mill; they could be coupled in with automatic blank feeding lines, taking the strip straight from the coil.

Mr. ROSE (Brookes (Oldbury) Ltd.) said that as a shear manufacturer he had found that when a shear would not cut a straight edge, this had been traced to strain in the sheet itself. It was checked fairly easily. If the sheet was split down the middle and two cut pieces put together the edges frequently would not join up. Would processer levelling take out these sort of strains?

Mr. BATTY said that in the case mentioned the fault was a rolling fault. During rolling, particularly in the old sheet mill, there was a variation in gauge across the width of the sheet, and this variation in gauge could only act in one way; the edges would hold in the centre because the edges were shorter and thicker than the centre. As soon as the material was split the locked-up stresses were released, allowing the material in the middle to take up its natural length. This could be corrected only by using pressure regulating roller levelling where it was possible to apply a differential pressure across the length of the machine by allowing the leveller to stretch one portion more than another. With a sheet which was tight on the edges and loose in the centre more work had to be put on to the edges of the sheet than the centre. A considerable amount of correction could be done in this way, producing a flat sheet, which, when sheared, would not give trouble. An alternative was to stretch the material under a hydraulic stretching machine, when the stresses would be released in the same way.

Mr. ROSE said that his experience was that stretching did cure this problem, but with material $\frac{3}{16}$ or $\frac{1}{4}$ in. thick, very few machines in the country would stretch material of that nature, and it was only on the thicker materials that the trouble occurred.

QUESTION: *The "safety factor" of press operators seems to vary considerably with different factories and different areas. Is this due either to the leniency or the strictness of the safety officers? Should there not be some standardization of safety that applies everywhere?*

Mr. MOORE replied that section 14 of the Factories Acts stated: "A dangerous machine must be securely fenced," and this applied in Hockley, Middlesbrough or St. Ives. How that should be carried out was in Official Recommendations which could be purchased from any bookseller or from H.M. Stationery Office. Various occupiers might try to "duck" the law and some might get away with it better than others, but that was not because there were no standard regulations for the whole country. It was inevitable that different Factory Inspectors would have a different interpretation of the recommendations but the regulations and the law were standard for the whole of the United Kingdom. In his experience, whether it was taken up or not depended on the conscience of the management. Some managements were very safety conscious, and others not so. The Factory Inspectors themselves did their best to see that occupiers kept within the law but a lot depended upon the conscience of the management.

Mr. UDAL said that there was no doubt that the standard in big plants was much better than that in smaller plants. Obviously if a plant had 500 presses the risk of an accident was very much higher than with, say, five presses. He thought the Factory Department Inspectors rather tended to measure results from a unit, irrespective of its size and they would make no allowance in relation to the big unit.

Bottom Drive Presses

QUESTION: *The Americans have boosted the idea of bottom drive for large presses. Is this a better constructional method than the conventional top drive?*

Mr. VALLANCE said he was beginning to think that the Americans themselves had regretted their decision on this type of drive unit. The original idea had been to increase the draw and speed of the units and to have the press floor area free of all clutter, with scrap dropping into a basement. However, the underdrive press, as such, had been in existence for about 70 to 80 years. It was soon found that it was not possible to clear the press floor of clutter; components and scrap were still there, as the outer cut-offs from blanks for car panels, etc., did not go down the middle of the press to the basement. It had been found impossible to move the bed upwards and a slide downwards to get double the pressing speed. It was not the tools in the press that fixed that but the quality of the metal and the speed at which it could be formed. It was also found impossible to get a cushion into the work, so a lot of mechanical difficulties occurred that had not been apparent in the first place.

Mr. SALMON (Austin Motor Co. Ltd.) said that maintenance of under-drive presses was not easy; when the crown of the press was on top, a lot of work could be very easily done with the crane, but with the drive in the basement the problem was much more difficult.

Mr. VALLANCE said that this was one of the predominant difficulties experienced. In the basement area the drive mechanisms, etc., were "sticking down from the ceiling." It was also necessary, as with a standard press, to allow cushions and bed to go down below. Thus the basement had to be exceptionally deep, but in general it was not deep enough for a crane. Therefore, fork trucks had to be used.

Mr. SALMON (Austin Motor Co. Ltd.) referring back to processing of sheet prior to pressing, said that with a leveller it was virtually impossible to break the sheet down sufficiently to get rid of stretcher strain. He knew of only one machine which would do the full flexing. Did he understand that there was another machine that was some half-way in between?

Mr. BATTY replied that up to about 90 per cent of the presswork could probably be done by using a straightforward roller leveller but with a modified arrangement of rolls but without the flexing roll. A much closer spacing of rolls was required to get a more severe bend in the metal, and the pinch rolls were also required to assist. The flexing roll did not always operate as safely as it should. Quite a length of material would go through before the flexing roll moved and that portion was only being treated in the leveller roll. The other unit mentioned had not yet been fully developed. This unit was likely to be quite costly, but he thought it would overcome all the disadvantages of the other two types of machine mentioned.

QUESTION: *What is the difference between a hydraulic and a mechanical press brake, and what are the advantages of a press brake over a folding machine?*

Mr. CROSTHWAITE said that the most important factor was the product that the customer was going to make. Speed of production was a predominant factor from the point of view of cost. The hydraulic press brake generally operated at a slower rate than the mechanical machine and came into its own on heavy plate where the time of handling of the plate was greater than with light components, and so the speed of operation was not such a vital factor from the cost of production angle. Another point about the hydraulic press brake was that it could not be overloaded. The mechanical machine could be overloaded, and provided the top and bottom beams were strong enough, and most of them were, and the usual safety factors incorporated, some overloading could be tolerated. Generally speaking, up to 250 tons a mechanical machine was the cheapest. Over 250 tons the hydraulic machines tended to be cheaper because a mechanical brake had to be designed to be stronger than its nominal capacity to allow for overload. The hydraulic machine could not exceed its rated pressure. A light folding machine was useful for small production or for a man starting a business, but for higher speed of production a press brake was required. He knew one man who had one 20-ton press brake on which, working one shift, he did the work of three folding machines working three shifts! The large type of folding machine did have certain advantages in certain applications from the point of view of flanging up thick plates. However, the ordinary mechanical press brake could be two-speed drive or could be hydraulic so that "inching" could be carried out if required. Generally speaking, the press brake was a much more adaptable machine, whether hydraulic or mechanical, than the folding machine. A press brake could do certain types of folding work, notching, etc., which could not be effected in a folding machine. However, it was possible to fold round bar in a folding machine, but production was slow.

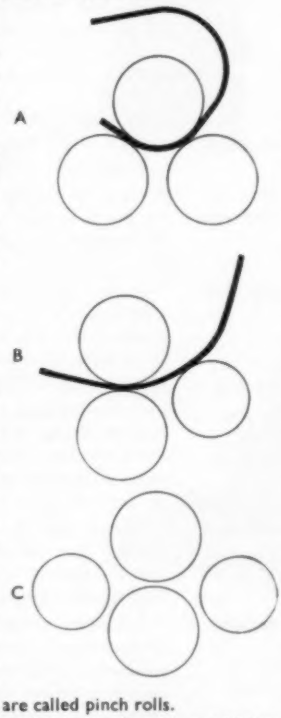
(*Continued in page* 374)

SHEET METAL DATA SHEET 5

Sheet Metal Rolling Machines–1

Compiled by J. W. Langton, M.B.E., B.Sc.(Lond.), M.I.Mech.E.

(1) BENDING ROLLS



In this group, perhaps the most common machines are those used to bend sheet metal into cylindrical or part cylindrical forms with either parallel or conical sides, by the bending rolls. They are more easily identified if they are called bending *rolls* and not bending machines.

Basic Principles and Types

Bending rolls have usually three rolls, but there are heavier and more elaborate types which have four rolls.

The three rolls may be arranged in pyramid fashion as A, and the rolls are termed pyramid rolls. The alternative arrangement, B, with one pair of rolls arranged immediately above one another, gripping the metal to be rolled between them, are called pinch rolls.

The four-roll sets are usually pinch rolls with an addition of a fourth roll as, C.

By changing the centre distance of the top roll in pyramid rolls from the other two rolls, whose centres are usually fixed, or by changing the centre distance of the third roll from the two gripping or pinching the metal, in the case of pinch rolls, the radius of curvature applied to the metal can be easily changed. It follows also that if in the case of the pinch rolls, the third or curving roll can be inclined to the other two, conical forms can be rolled.

When considering the rolling action (and perhaps this is best seen from a consideration of the pinch rolls type, although there is a similar effect with the pyramid type) the metal has to pass through the pinch rolls for a little distance (dependent on roll diameters) before any bending action begins, and when it does the first portion of the metal is not rolled to cylindrical form but bent about from a point where it leaves the pinch rolls to where it strikes the curving roll, so that the start of the curve has a flat. At the end of the rolling there is a similar flat left, as there is no bending action on the last portion after it leaves the pinch rolls. These flats are left similarly in the pyramid types, and here, in certain circumstances, the results might be worse.

One remedy is to 'start' or preform the beginning and end of the sheet before rolling, either in pressure dies or by the use of the rolls themselves. For example, in the four-roll machine, the metal can be first just gripped in the pinch rolls, and then one of the side rolls may be brought up to form this 'start.' After a first rolling operation, this side roll may be moved away and the final form produced by bringing up the other side roll. A very elementary method of securing the same effect in much lighter work, is to grip the sheet in the pinch rolls and give the start by hand bending the sheet. Sometimes the final form is corrected, after the joint in the cylinder has been made, by re-rolling them.

Roll Sizes and Capacities

It should be realized that rolling cylindrical work can be a deforming operation of some magnitude, particularly when rolling small-diameter cylinders. Consequently, the reaction of the material to it can be great and so this is a very large factor when considering what can be rolled in any particular set of bending rolls. This material consideration, should take into account many of the main physical properties of the material besides its tensile strength. Never be surprised, therefore, at the varying results which might accrue when rolling sheet metal.

In the main two groups of bending rolls, *viz.* those (*a*) operated by hand power; (*b*) those operated by power drive of some kind, it is conventional usually to specify the hand power by length and diameter of rolls, and the power driven in maximum width of sheet and thickness rolled. One of the underlying reasons for this is that in the case of the power rolls the exact power input is known, but in the case of the hand rolls the power input varies considerably.

There are two other factors not always mentioned when considering bending roll capacities; (*a*) diameter which is to be rolled; (*b*) number of passes possible economically.

Generalizing, the minimum diameter which can be rolled is of the order 1½ to 2 times the diameter of the roll round

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SHEET METAL DATA SHEET

Sheet Metal Rolling Machines — 1 (Cont.)

which it is being rolled ; in what might be regarded as a maximum number of passes, from an economic point of view. The minimum diameter rolled in one pass can vary anything from somewhere near four times the roll diameter upwards, the material itself being a great deciding factor here.

TYPE DETAILS

Hand Power Machines

First general specification is the length and diameter of the rolls. If the roll diameter is not known, the metal thickness and details.

Lengths The maximum length in hand rolls is usually 10 ft. and the minimum about 12 in.

Metal Thicknesses The maximum metal thickness usually dealt with by hand power machines in mild steel (28/24 tons) is $\frac{1}{4}$ in. and the maximum length in this thickness is 4 ft. In similar material, $\frac{1}{8}$ in. thick, 6-ft. machines are possible.

Capacities As mentioned earlier, the maximum metal thickness the rolls will cope with is not usually given, and selection of size has to be made empirically, considering metal thickness, diameter to be rolled, length to be rolled and number of passes relatively with one another. The following gives some approximate ideas of what might be expected:

Rolling	18 *s.w.g.*	*(Length and Roll Diameter)*
37 × 2	73 × 3	97 × 4
Rolling	16 *s.w.g.*	
37 × 3	49 × 4	73 × 4
Rolling	14 *s.w.g.*	
25 × 3		

The minimum diameters rolled in these lengths with several passes possible would be of the order 9 to 12 in. For thicknesses above 14 s.w.g. the roll diameters may not be much larger, but the machines are more robustly designed and better geared.

Slip Rolls When rolling complete cylinders, the finished cylinder is obviously left round the roll, so provision has to be made for its removal. Rolls with this provision are called Slip Rolls, *i.e.*, the roll is made to slip out sideways. When considering rolls for purchase, this point of type of provision made, can be very important, having a fundamental effect on output.

Geared Rolls In the hand range, there is usually a differentiation between geared and ungeared rolls. The gearing addition means, of course that more work can be done, and unless the rolls are for very light gauges alone, they are to be preferred.

Manufacture Today these hand rolls are available with cast iron, alternatively fabricated (all steel frames). The latter have the virtue of being, in practical terms, unbreakable. The rolls themselves, being only for light gauges, are usually low-carbon steel. Note they are usually grooved at one end for wire forming, which may not be required.

Mechanical Power Rolls

Lengths There is no marked restriction here, but the most common lengths are 4, 6, 8 and 10 ft.

Metal Thicknesses There is no definite restriction here either, but the main remarks in this data sheet are for machines to deal with plate up to about $\frac{1}{2}$ in.

Capacities Thickness capacities are stated, but not usually coupled with diameters or number of passes. Here it is best to seek tests on the actual material to be rolled.

Slip Rolls Practically all mechanical power rolls have some form of drop end for cylinder removal. Support for the top roll after dropping the end is advisable. The procedure for cylinder removal should be carefully studied regarding the time involved.

Gearing All power rolls are geared, and the whole power input should be studied—size of motor—together with ease of operation. High quality engineering here is essential.

Manufacture In comparing machines, heed should be taken of robustness. Resistance to deflection is exceeding important if something like parallel cylinders are to be rolled. Fabrication plays a large part here. The rolls are usually of higher carbon steel (0.4 to 0.5).

Rolling Corrugated Sheets

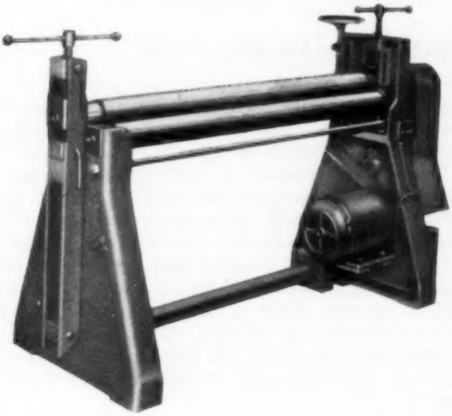
Hand and mechanical power machines can be obtained for rolling corrugated sheets. The rolls here have then to be shaped to suit corrugations. and the roll widths made to suit standard sheets, usually 33 in. or 39 in.

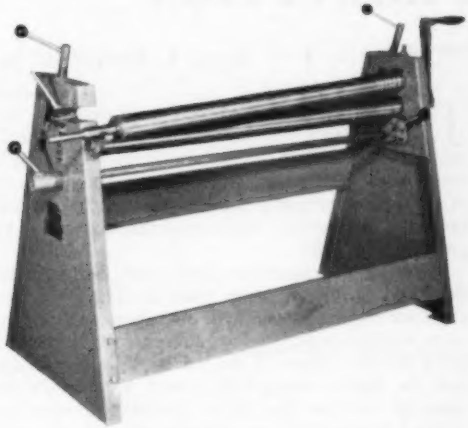
Cone Rolling

It is possible, as mentioned previously, to do a certain amount of rolling of cones on both hand and power rolls, providing there is provision to move the curving roll to a suitable angle in the horizontal plane to the pinch rolls, or in pyramid rolls, to the other two. If this cone rolling feature is necessary it should be considered at the outset.

SHEET METAL DATA SHEET 5

Sheet Metal Rolling Machines — 1 (Cont.)





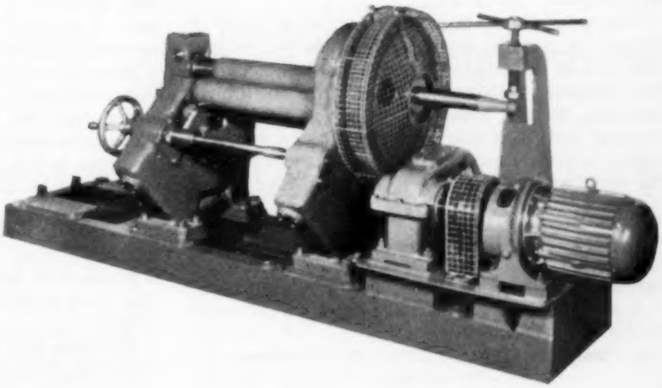


Fig. 1 (above).—Power pyramid rolls (3 rolls) with swing-down end

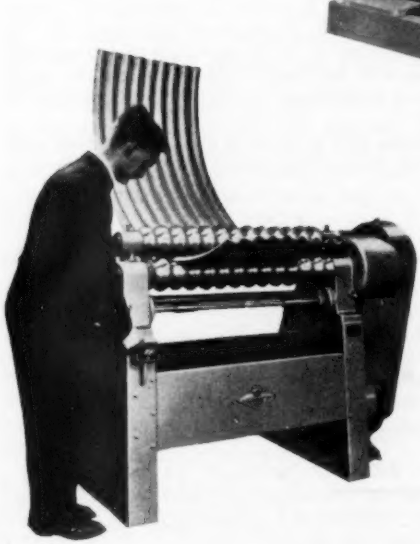


Fig. 2 (Top).—Hand power slip rolls ungeared

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Fig. 3 (above).—Heavy power geared plate rolls

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Fig. 4. (left).—Bending rolls for corrugated sheets

DESIGNING FOR PRODUCTION • 6

Quantity Methods

(*Continued from page* 655, *October*, 1959)

By J. V. HARDING, A.M.I.Mech.E., A.M.I.Prod.E.

THE production methods employed in the manufacture of large quantities of sheet-metal parts, are well defined and include the simple hand feeding of blanks into a press tool, the use of a transfer press, and the feeding of strip material through compound and progressive tools, by power, or by hand.

Consider a progressive press tool, designed for the hand feeding of strip material (Fig. 1). Two stops are required ; the first, initially to position the strip, and the second, to locate the strip at the correct pitch for each blow of the press. The initial stop may be lightly spring-loaded and it positions the material for the first blow, thereafter being depressed by the strip, as it passes through the tool. Alternatively, a pin stop, pulled out by hand after the first blow, may be used.

The second stop is in the form of a finger or trigger, operated by a strike pin on the top bolster. The end of the trigger locates against the edge of the previously blanked aperture. As the punch descends, the pin strikes the trigger and raises the locating end. As the punch begins to rise, the trigger is in the raised position long enough to allow the strip to be fed through, and the edge of the previously blanked aperture finally locates against the trigger stop. The operator simply maintains a light forward feed on the strip.

Where close control of pitch must be maintained, it is necessary to use locating pins on the punch or the punch plate, to locate in a previously punched hole and provide final accuracy of position. When locating pins are used in the hand feeding of strip, the feed pressure is relaxed slightly on the down stroke, to allow the pins to fully control strip position. With power feeding of strip by pinch rolls, the rolls open as the ram descends, again allowing the pins to control strip position.

Power-feeding methods vary with the type of press. A standard power press employs pinch feed rolls, actuated by a link mechanism from the press ram. Fast-stroking die presses employ feed rolls operated directly from the press crankshaft.

Disposition of the blank on the strip is important, and considerable economy may be effected, by considering this at an early design stage. For example, a simple L-shaped blank may be disposed as shown in Fig. 2. The scrap yield varies in each case and is an obvious factor in selecting the best blank position. If a fold is required in a part, it is usually best made across the grain of the material. Grain is in the direction of rolling, that is to say, with the length of the strip, and the blank may need positioning to take advantage of this for folding.

Referring to Fig. 2*c*, it is obvious that tool costs have been increased as double blanking is employed.

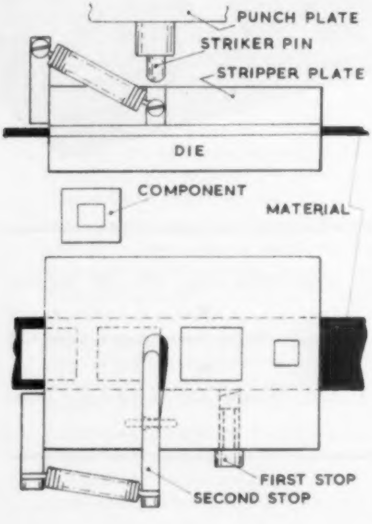
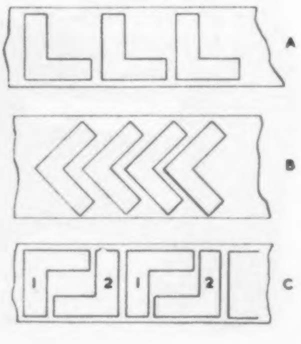


Fig. 1 (*left*)

Fig. 2 (*right*)



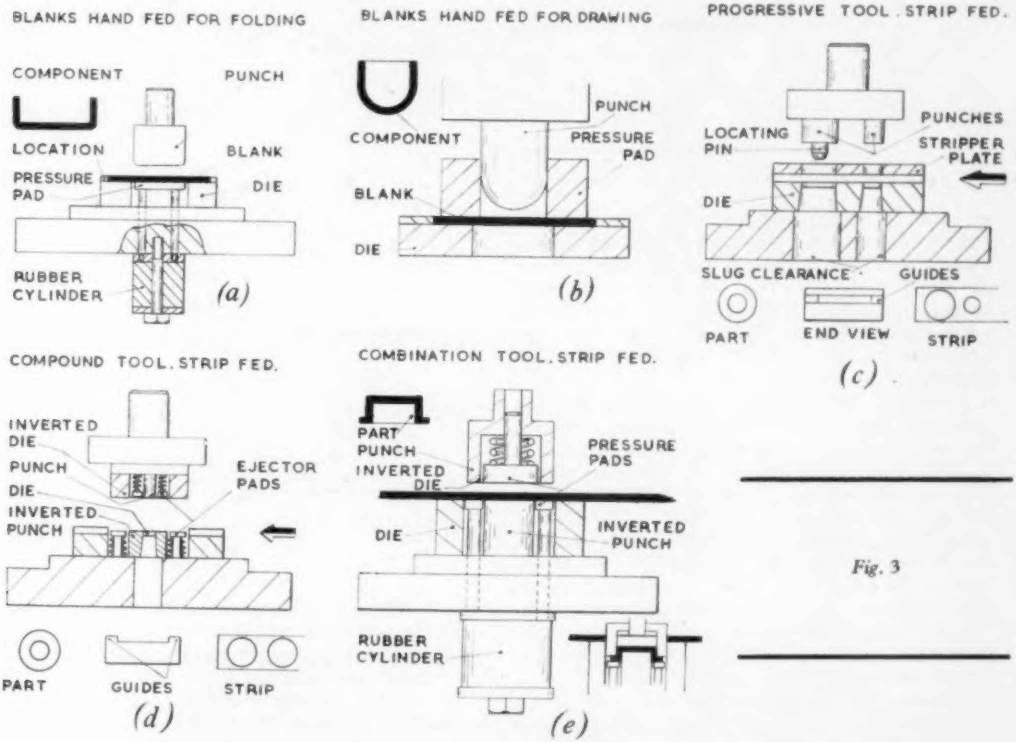


Fig. 3

The press tool is made with two punches and produces blanks 1 and 2, with each stroke of the press. To avoid the increased tool cost, a single punch tool is made, and the strip passed through the tool once; it is then reversed and passed through again.

Tool design is essentially the province of the production department, but the designer with a basic knowledge of simple press tools, is better equipped to design for economical production. Certain of the basic types of press tool are shown in Fig. 3.

The power feeding of strip, involves the use of additional equipment to the press and tool. Coils of strip may be heavy, or the material a thin gauge and easily damaged. In either case, special equipment for holding the coil is required. For light coils, coil stands are used. These have adjustable arms to suit the centre of the coil. They are usually unpowered with the coil rotating freely, while the metal is pulled from the coil by the straightener rollers.

Heavier coils are supported in a coil cradle, Fig. 4. This has supporting rollers in the base and is powered or unpowered. The powered version is to be preferred in most cases, as the unwinding of heavy coils by the straightener rolls, causes the strip to drag and this may introduce pitch errors. The powered version reduces the load on the straightener rolls, and eliminates the drag effect.

The close coiling of strip gives it a pronounced curve, and this must be removed before the material passes through the press tool. Straighteners are employed for this purpose, consisting of a series of powered rolls, so arranged, as to straighten the strip as it passes through the rolls.

The action of the power press is intermittent, and the feed of the strip is continuous. To cater for this difference, a slack loop is introduced between the straightener and the press tool. The loop lays on a switch arm, which actuates a relay to cut out the feed motor. If the loop becomes too long, the feed motor is cut out. As the loop shortens, the switch arm rises, eventually operating the relay and starting the feed motor (Fig. 5).

Several versions of the basic arrangement are available and vary with the material, type of tool and similar considerations. Fig. 5 is intended as a guide only, and an introduction to the additional equipment required for this class of work.

To order material for press work, both technical and production knowledge is required. Materials

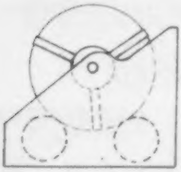


Fig. 4 (*left*)

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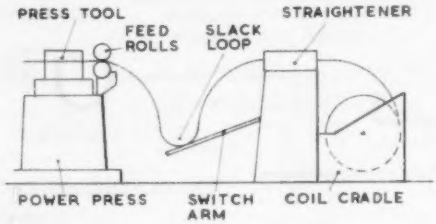
Fig. 5 (*right*)



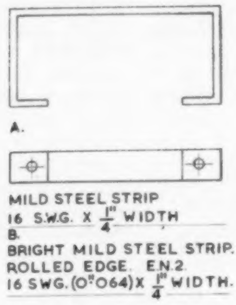
are made to many specifications, finishes and conditions, for example: steel strip is available with a rolled or sheared edge, steel sheet, with a black or bright surface. The non-ferrous materials, copper, aluminium and brass, are available in various temper grades. These and other factors are important to the designer and the production engineer.

Functional requirements are probably the first conditions laid down for a particular material, but if the selected material is not available in a suitable form for manufacture, or cannot be worked economically, then an alternative will be required. Design may call for a particular material, in a gauge that is consistent with the required strength, but in manufacture, this material must be reconciled to the methods available for folding, drawing, blanking and generally working, to produce the required part. Clearly it is not sufficient to design for function only, rather is it necessary to *design for function and ease of production*.

Consider the simple handle shown, Fig. 6A. Mild steel fulfils the strength requirement and is a ductile material, readily worked. The part is finished in a hammer grey paint, and can be treated before paint, to withstand corrosion. However, the drawing is inadequate for the following reasons. The part is a handle and sharp edges must be removed. It is to be painted, and paint quickly wears from a sharp edge. By calling for mild-steel strip, sheared-edge strip will be purchased, and the part will need all sharp edges broken; an extra operation. Mild steel is available to certain specifications, and in this case, a "bending quality" is required. EN2, is a mild steel subjected to a 180 deg. bend test and can be safely used for the part. The revised and additional information is shown in Fig. 6B.

The grades of temper in sheet steel are primarily controlled by the extent of the cold rolling during manufacture. There are four grades; dead soft, medium soft, half hard, hard rolled. Brass sheet is available in a range of temper grades from hard to soft. Certain basic alloys are accepted as suitable for particular work, for example, cartridge brass, this is a 70 per cent Cu-30 per cent Zn alloy and it is ideal for drawn parts. A part with a shallow draw may be called for as half-hard material, and with work hardening during the draw, will toughen by the required amount. For a deep draw, a soft-

Fig. 6 (*right*)



temper material is required, as the metal is subjected to additional work-hardening. Aluminium is also available in temper grades from hard to soft and similar considerations apply.

We have previously considered certain aids to production in designing for the manufacture of small quantity sheet-metal parts, and in conclusion, these may be summarized :—

(1) Uniform apertures in line and positioned from a datum edge reduce press setting time. A fixed back stop can be set and used in conjunction with swinging gate stops.

(2) Maximum tolerances consistent with functional requirements, should be allowed. Close tolerances require group tools, with increased cost.

(3) Ensure that press capacity available, is adequate for the job. This refers to tonnage, also physical size of press, throat depth and bed size. Use available standard tools whenever possible.

(4) Where folding is required, provide tooling holes parallel to the fold so that the pin method of location can be used; for double folds this is a cheaper method and also yields consistent work.

(5) Use the lightest gauge possible to reduce tonnage required for blanking and folding, also to give longer tool life. A fold along the length of 20-s.w.g. material (0.036 in.) gives comparable strength to 16 s.w.g. (0.064 in.), unfolded. Gives reduced weight and simplifies manufacture.

(6) Ensure that blanks are of a size that yields the maximum number from a standard sheet, with minimum off cut or scrap material.

(*Continued in page* 373)

Professor A. J. MURPHY, M.Sc., F.I.M., F.R.Ae.S.

(President of the Institution of Metallurgists)

Portrait of the Month

Professor A. J. MURPHY, M.Sc., F.I.M., F.R.Ae.S.

PROFESSOR A. J. MURPHY, President of the Institution of Metallurgists for the session 1959-60, is Principal of The College of Aeronautics, Cranfield, an appointment he has held since 1955.

Graduating with First-Class Honours in chemistry at the University of Manchester in 1920, Professor Murphy carried out metallurgical research at University College, Swansea, from 1920 to 1923, and then transferred to the Metallurgy Division of the National Physical Laboratory. Leaving the N.P.L. in 1931, he became Chief Metallurgist of J. Stone and Co. Ltd., London ; he was appointed a Director of the company in 1946 and also of Light Metal Forgings Ltd., and Stone-Fry Magnesium Ltd., of which company he was chairman. In 1949 he was appointed Professor of Industrial Metallurgy at the University of Birmingham, an appointment he relinquished in 1955.

Professor Murphy was President of the Institute of Metals 1951-1952, and Chairman of the Inter-Service Metallurgical Research Council 1949-55 ; he is a Member of Council, and formerly Chairman of the Research Board, British Non-Ferrous Metals Research Association, a member of the Board of Scientific and Industrial Studies of the National Council for Technological Awards, and a member of various Research Committees of the Department of Scientific and Industrial Research and of the Aeronautical Research Council.

His principal subjects of recent research and interest include fatigue, crack propagation and effects of kinetic heating in aircraft structural materials, constitution and properties of special bronzes and metal economics. His earlier work included the constitution of dental amalgams, causes of breakage of iron lifting chains and hooks, and aluminium and magnesium alloys for service at raised temperatures, etc.

Professor Murphy has given many papers on metallurgical subjects before British Societies including the Institute of Metals, Iron and Steel Institute, Royal Society, Institution of Mechanical Engineers, and the Royal Aeronautical Society, and his book " Non-Ferrous Foundry Metallurgy " was published in 1954 by Pergamon Press, London (McGraw Hill, New York).

A NEW COIL-TAILING DEVICE

for Pickle Lines and Cold-Reduction Mills

By M. SMALLWOOD, A.M.I.Mech.E.*

DURING the last decade it has been increasingly apparent that the tailing and feeding of coils at pickle lines and cold-reduction mills used manual labour very inefficiently and several designs have been put in hand for doing this work mechanically.

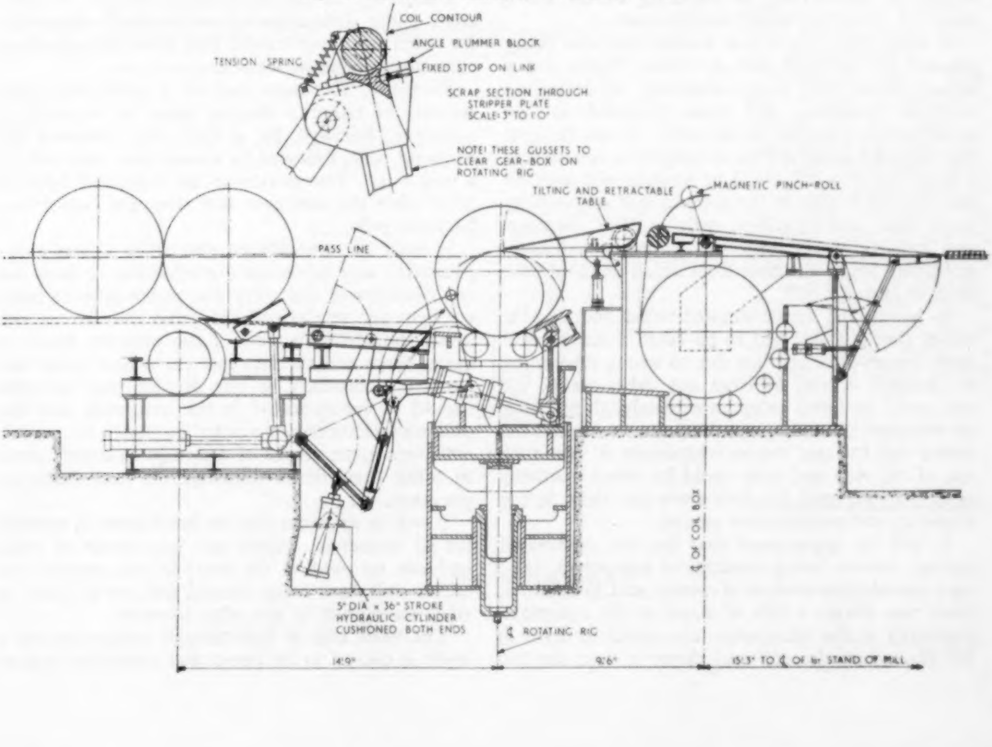
This problem was studied at The Steel Company of Wales and various schemes were devised to eliminate manual labour altogether, but they all had disadvantages which outweighed their advantages.

* Steel Company of Wales Ltd.

As an example, most of the arrangements devised utilized overhead structures, which meant that it was difficult to get at any equipment underneath for maintenance, such as backspin roll assemblies, especially if such equipment had to be lifted out by an overhead crane. Also, there were many moving parts, such as rollers, requiring balancing and general maintenance, which meant that although the equipment, as designed, would work, time would be lost during the short planned maintenance periods available.

During 1956 an idea was born for putting a tailing device below shop-floor level, but it was

Fig. 1.—General drawing of coil-tailing device



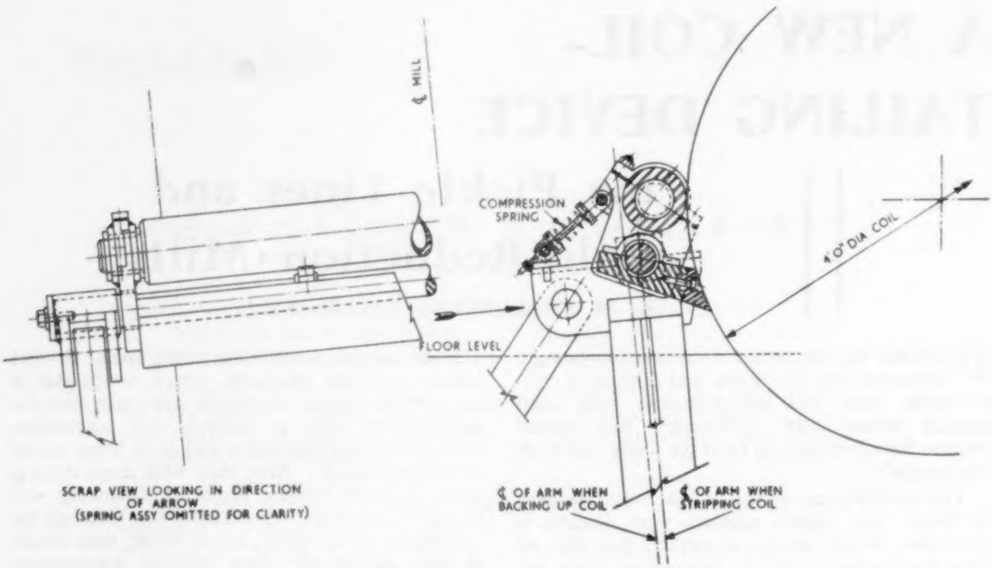


Fig. 2.—Drawing showing knife and roller of coil-tailing device

found impracticable to put such equipment into the entry end of a pickle line or on a mill which was already in production, as respacing of the entry ramps or conveyors would be necessary.

At about this time a new 4-stand mill was being planned for the cold mill at Abbey Works and a tailing device and feed, consisting of travelling overhead magnets, had been included in the manufacturer's tender for the mill. It was thought that this idea could not be developed to ensure that a single lap of a coil could be straightened and fed into the pinch rolls of the 4-stand mill successfully every time, and therefore, early in 1957 drawings and models were made of a device normally ambushed below the floor level which would do the work of tailing a coil.

By having the device situated below floor level it meant that if a coil had to be taken from the mill entry conveyor or coil box due to wrong scheduling or changed orders, or from any other cause, the coil could be lifted away immediately, there being no overhead structure, and furthermore, should the device fail for any reason whatsoever it would be out of the way and coils could be tailed manually as in the past until the device was put right during a normal mill maintenance period.

It will be appreciated that the old method of tailing, besides being wasteful of manpower, used up a considerable amount of energy, and, in addition, there was always a risk of injury to the operators, especially at the time when the operators have to lift the tail of the coil and throw it over the coil itself on to a table or on to the coil already being processed.

The design of the tailing device sought to overcome these difficulties by mechanically throwing the tailed portion of the coil over on to the preceding coil already being processed.

Normally, the entry end of a production line consists of either a sloping ramp or a powered conveyor, followed by a coil stop, followed by backspin rolls, followed by a cone-type feed reel or a coil box. The device to be explained later is fitted after the conveyor coil stop and before the backspin rolls.

It must be remembered that while it was comparatively easy to design a mechanism to cater for one diameter of coil, very few pickle lines or mills work on one size of coil only, and this fact caused much thought. In view of the progress made in design work and the fact that the model made had worked successfully, it was decided that the idea should be incorporated in the new mill, and the mill manufacturers were called in, shown the model, and were given copies of drawings to enable them to make their detail drawings for manufacturing purposes.

It will be apparent that the mechanism is suitable for all diameters, widths and thicknesses of coils, and can be used at the entry of any process line where coils have to be opened and can be used on steel, aluminium or any other material.

The basic idea is that through linkage motion a knife is caused to be raised and cushioned against

a coil; the coil being on the backspin rollers. The coil is then rotated in the normal manner; the tail of the coil being peeled off by the knife and falling away beneath it. When a sufficiently long length of tail, as required by the following process, has been unwound it is wound against a bending edge which has the effect of giving a certain length of straight on the tail of the coil.

It was also decided that in order to throw the straightened tail over the coil and to accommodate various diameters of coil the backspin rolls should be caused to raise and lower. This was done, as, indeed, it was on the model and it was found to work successfully.

Fig. 1 shows the opening device situated between the end of the conveyor and motorized backspin rolls. A coil travels along the conveyor and is held in readiness by the stop at the end of the conveyor. When the preceding coil has been delivered into the coil box the backspin rolls are raised into their maximum "up" position and the conveyor coil stop lowered, thus allowing one coil to roll over the opening device on to the backspin rolls. The conveyor coil stop is again raised and another coil brought to that position.

The opening device on the 4-stand mill referred to is operated by a hydraulic cylinder cushioned at both ends, but other forms of motive power could be used. When the entry end operator of the mill has placed his coil on the backspin rolls the hydraulic cylinder is energized, which causes the linkage to open a flap which is, in effect, the floor over which the coils roll. As the flap is being opened extensions to the linkage cause a spring-loaded roller and knife to appear from ambush and come to rest on the steel band tying the coil. A slight movement of the hydraulic valve causes the knife blade to cut the band and the coil is then rotated so that the tail is moved away from the coil by the knife blade, which is wide enough to take the maximum width of coil on the mill.

While the coil is rotating the end of the tail is caused by the knife to pass under the flap and is directed below floor level. When a sufficient length has been unwound the backspin rolls are stopped and the knife withdrawn back again into ambush. This causes the flap to lower and the whole is stopped just before it reaches its final closed

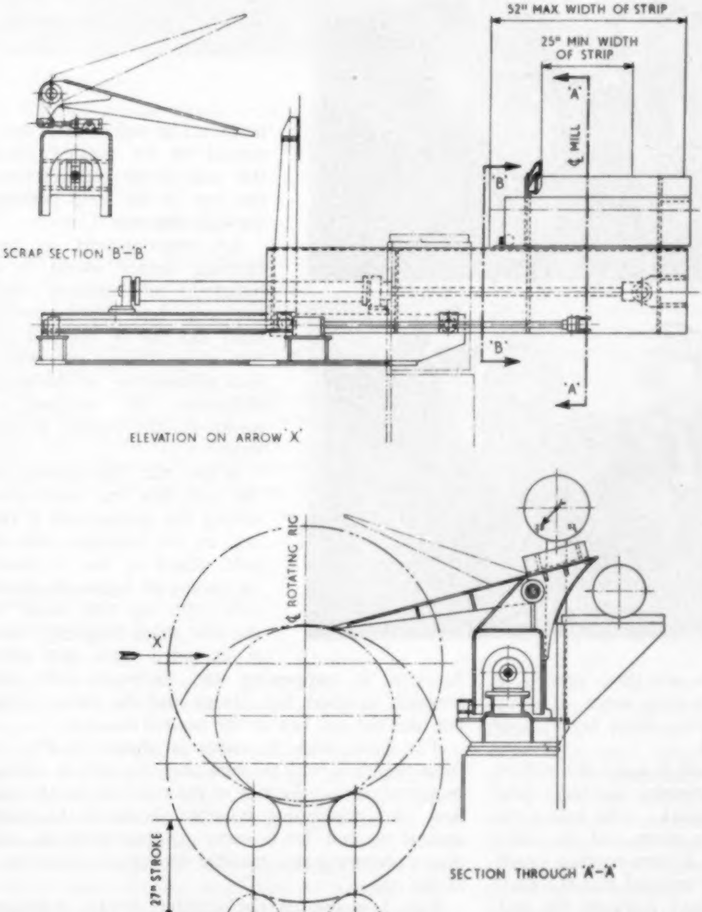


Fig. 3.—Retractable carry-over table

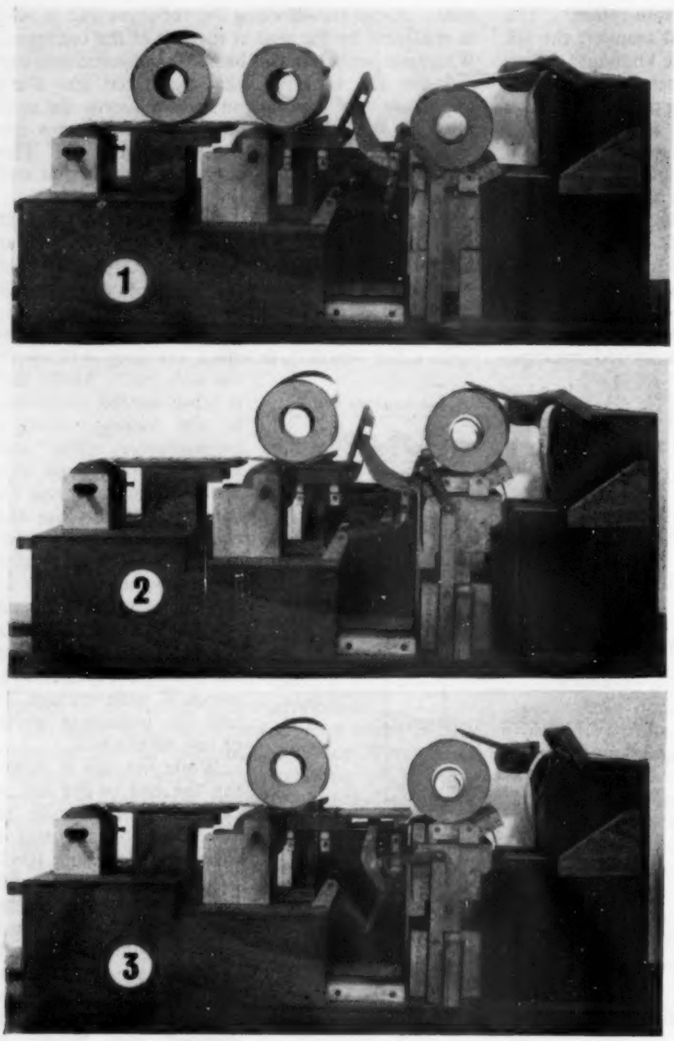


Fig. 4.—Model of mechanism in various stages of operation

(1) *This shows coil having been tailed with leading edge resting on carry-over table and knife mechanism up against coil ;*

(2) *First coil is here in coil box and second coil has been rolled on to backspin rolls. Tail of coil just under knife ;*

(3) *Tailing mechanism practically in " down " position with tail of coil being straightened. Tail is below floor level*

position. The backspin rolls are then rotated in the opposite way in order to once again wind up the coil; the tail end appearing from below floor level in a straightened length.

When the end of the coil tail is again above floor level the coil is rotated the opposite way for a short distance and the flap again raised. This brings the knife and the roller up once more and the roller supports the tail. The coil is then rotated slowly whilst the backspin rolls are lowered and the knife with its roller moved forward towards the coil. This has the effect of throwing the straightened tail over the top of the coil on to a retractable carryover table. The coil is then continued to be rotated until the end of the coil rests on the top of the strip passing through the mill.

An improvement on the opening device would be a magnetic roll situated over the coil box which would hold the tail of the coil off the strip being processed, thus minimizing or obviating altogether the danger of scratching the surface of the strip.

When the coil already in the coil box has been processed the leading tail of the coil on the backspin rolls is held ahead of No. 1 Stand by means of a pair of pinch rolls (this top roll could be the one made magnetic) and is threaded into the mill. As this is happening the backspin rolls are lowered to their full extent and the coil is tilted out into the coil box in the normal manner.

The knife with its roller is shown in Fig. 2, from which it will be seen that the unit is spring mounted so that the face of the roller meets the coil first, this cushioning possible shock of the knife against the coil due to some careless operation, and thus preventing any possible damage to the surface of the coil.

Fig. 3 is one of the original design drawings showing the retractable carry-over table which

(*Continued in page* 373)

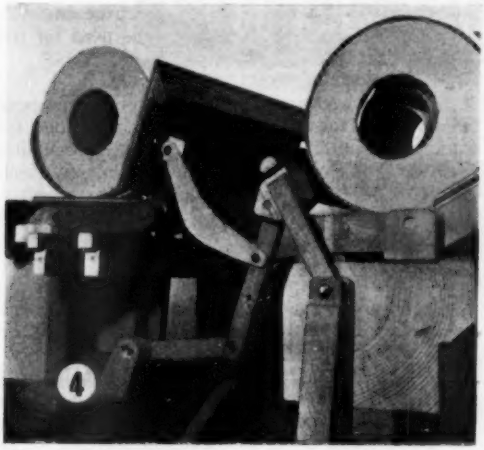
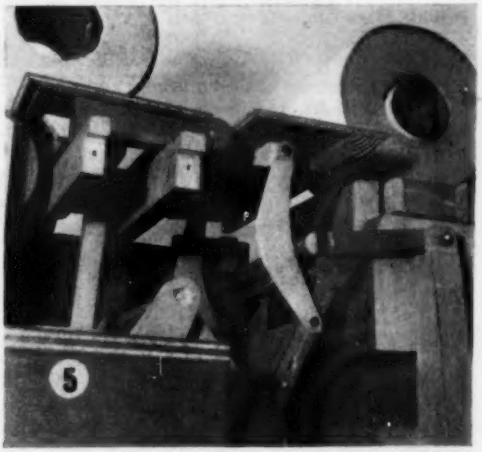


Fig. 4 (*continued*)

(4) *Close-up showing linkage in more detail. Coil is in same position as in* (2) ;



(5) *Close-up showing tail being formed. This is similar to* (3).

Coil Tailing Device

(*Continued from page* 372)

supports the tail of the strip after it has been thrown over the coil, and also incorporates a side guide so that the strip is automatically centred ready for entry into the mill.

Five photographs (Fig. 4) show the model at the various stages of tailing.

Fig. 4 (1) shows a coil having been tailed with the leading edge resting on the carry-over table and the knife mechanism up against the coil preventing the tail from falling backwards from the table.

Fig. 4 (2) shows the coils shown in Fig. 4 (1) having been advanced. The first coil is now in the coil box and the second coil has been rolled on to the backspin rolls and the tail of the coil is shown just under the knife.

Fig. 4 (3) shows the same coil with the tailing mechanism practically in the "down" position with the tail of the coil being straightened. The tail can be seen below floor level.

Fig. 4 (4) is a close-up of the device to show in more detail the linkage. The coil is in the same position as in Fig. 4 (2).

Fig. 4 (5) is a close-up showing the tail being formed and is similar to Fig. 4 (3).

The mill went into production on May 1, 1959, and the opening device has worked successfully ever since.

Designing for Production

(*Continued from page* 368)

(7) Where large notches are required, as in a folded assembly, consider fabrication as an alternative, to reduce the scrap losses of a large notched corner.

(8) Design parts of spot-welded assemblies for simple sighting or interlocking into position. This enables full advantage to be taken of the speed and low production costs of the process, by the elimination of fixtures.

(9) Check capacity and physical size of spot welders and riveting machines, to ensure components can be handled on the machines available.

(10) Check with painting and plating departments whether tooling holes will assist in any of the finishing processes, *e.g.*, suspension for plating or mounting for painting.

Finally, it is important to appreciate, that although the examples discussed in this series are of a simple nature, the same underlying conclusion can be drawn from each one ; that design and manufacture, or function and production, must be fully integrated before maximum economy and efficiency is obtained. The end product begins on a drawing board and passes through several stages before completion. It is only logical that the designer must have some knowledge of these stages, not to the extent of a specialist in any one of them, but sufficient for him to design with them in mind. This demands practical experience on the part of the desinger ; all too frequently lacking in industry today.

Finish Blanking—Discussion

(*Continued frcm page* 356)

there was a pressure of the knife edge and a pressure underneath, both of which were squeezing the metal, first on the punch and, second, into the die to give close contact and prevent slipping. In the finish blanking explained by Mr. Howard, the same effect was obtained by putting a radius on the die. He wondered whether there would be any improvement if, instead of having 0.0005 in. clearance between the punch and the die there was 0.0005 in. interference.

Mr. HOWARD said that the suggestion was very tempting—to have an over-sized punch in relation to the die. In fact, he tried it but the results had not been good. With the power presses which he used for the process, a certain amount of deflexion was obtained. This was bad enough with 0.0005 in. clearance, but it would be very much worse with 0.0005 in. interference—and the die life would be seriously impaired.

Mr. HAAG said that in the watch industry in Switzerland it was quite normal to use an over-sized punch, but only for brass; the method would not work for steel. The finish obtained on brass was quite good. The two methods which he and Mr. Howard had described would not be used for the same application.

Mr. HOWARD agreed.

Mr. HAAG said that there was not one component which Mr. Howard had shown in his slides for which he could recommend the fine blanking technique. On the other hand, the samples which he had circulated—with one or two exceptions—could not readily be blanked with Mr. Howard's technique.

Mr. HOWARD agreed.

Mr. HAAG said that the tool involved in his technique was a special tool and needed very skilled toolmakers. There was no clearance at all between the punch and the die.

Dr. WALLACE said that in the work of T. M. Chang, reported in 1948 or 1949, the use of radiused dies and interference between punch and die was shown to give a better finish to the blank product. The work was done on a very slow press.

Mr. HOWARD said he was aware of Dr. Chang's work which had included a reference to "deliberately blunted" dies. This had been taken into consideration when planning his own finish blanking investigations.

"Presses and Press Shop Equipment"

(*Continued from page* 362)

QUESTION: *From a productivity point of view what are the advantages of an air-operated clutch over a key clutch? If there are none, why are we called upon to face the hazard from a safety point of view?*

Mr. VALLANCE thought that industry in general was not fully accustomed to the use of the air clutch and still preferred a mechanical clutch. His own view was that mechanical clutches ought not to be made. He would rather have every press equipped with air clutch because, in spite of what had been said earlier, safety could be achieved with an air clutch better than with a mechanical one.

The latest innovations were to equip C-frame presses with air clutches in order to give industry generally the higher productivity they were looking for; this could be obtained with greater safety than with a mechanical clutch.

Mr. BURTON (Hordern, Mason and Edwards Ltd.) thought that for normal second operation work, at normal speeds, the key clutch was preferable. Specialized applications, *e.g.*, high speeds, required an air clutch. There were other forms of applications where the air clutch had an advantage over a key clutch, such as with some mechanical types of feeding, but it also had the main advantage that it could be disengaged at any point in the stroke, whereas in the main key clutches of any kind, once the stroke had started it had to go full circle, unless a secondary extractor which was not completely satisfactory was added. It was much easier to interlock with any type of feed mechanism a friction clutch, but for reliability at normal speeds he still thought that the old key clutch was the best.

Design of Power Presses

(*Continued from page* 338)

design creates its own particular form of "good and pleasing" appearance.

The crank press with a cast-iron frame has the great advantage of ready accessibility and if its design is sound it can be relied upon to turn out good work for a very long period. The totally enclosed eccentric press has the advantage that its gears and transmission can be adequately protected from dust and they can run in oil, but to quote an old saying "out of sight out of mind." It is possible when the working parts are not visible to forget they are there and also to forget to keep them well provided with oil.

The author's company manufacture crank presses with cast-iron frames and tie rods and also totally enclosed steel fabricated eccentric presses. But, as in every field of activity, no one device or type of machine is universally applicable for every duty and the interest of the user can best be served by having available alternative types.

SHEET METAL NEWS

FEATURING EVENTS AND PERSONALITIES IN THE INDUSTRY

FIRTH-VICKERS CELEBRATE FIRST 25 YEARS

General view of double-duo mill

IN spite of recent additions to the Firth-Vickers works, the increasing demand for stainless steel has necessitated yet further extensions. The new £2-million expansion scheme at Shepcote Lane Rolling Mills is already under construction and is expected to be in operation, producing mainly stainless-steel wide strip in coil, by the second half of 1961. At present the mills are producing 400 tons a week of stainless-steel coil up to 40-in. wide and the new expansion will nearly double this output.

In line with the increase in the production capacity Firth-Vickers are also expanding their warehousing and processing plant sections to cope with the increase.

The main additions to the mills will consist of a second 42-in. Sendzimir cold-rolling mill and a fourth softening and descaling line, together with extensions and modifications to existing ancillary plant, as well as the installation of an extra coil build-up line and a new furnace for softening ferritic steels.

Rod and Bar Rolling—Staybrite Works

Much new equipment has already been installed for rod and bar rolling, including an 18-in. cogging mill built by Brightside. It is a single stand 3-high mill with 48-in. barrel rolls. Its purpose is to cog billets which are generally 5-in. square down to smaller billets for the plant's small mills. The 5-in. square billets are supplied by the parent companies of Firth-Vickers and are approx. 700 lb. max weight. The billets are conveyed to the mill and from the mill to the shears by powered roller tables. The mill is equipped with an electrically powered lifting table and drag-over skids to position the billets in line with the roll passes. The outgoing table of the mill conveys the rolled billet to an electric up-cut shear of 250 tons max. blade load. After shearing, a short roller table conveys the billets to a rope-drawn transfer skid, where after cooling they are bundled and weighed prior to dressing. The tables of the mill are controlled from a pulpit by one man who also has the oil and grease supply, etc., warning lights in vision.

Also installed is a Brightside 18-in. finishing mill. Sections from this mill include rounds up to 4½-in. dia., hexagons 2¾-in. a/f, large and medium flats, squares, turbine sections, angles, etc. Also rolled are strip coils up to 10⅜-in. wide by 4g. thick for further processing and cold rolling at the company's strip mills.

Because of the wide range of billet and slabs required for the mill, etc., a walking-beam type furnace has been installed to serve it.

After rolling, sections are conveyed by roller table to a 48-in. pendulum-type hot saw if required, or in the case of strip to a small downcut shear and upcoiler.

The mill has three stands, *viz.*, two 3-high and one 2-high. The middle stand is run as a 2-high or 3-high as required. The end finishing stand which normally takes 48-in. barrel rolls can be closed in to receive 24-in. barrel rolls as used for the finishing passes on strip.

Another piece of new equipment is a Brightside 10½-in. double-duo mill. On it is rolled by either hand or guide methods—rounds up to 1¾-in. dia. down to $\frac{5}{16}$-in. dia., hexagons, turbine sections, angles, flats, squares, etc. It is a six-stand mill with five duo stands and one end single pair finishing stand. The mill is served by two gas-fired batch furnaces. Rolled bars in multi lengths from the end stand are conveyed by roller table to a 36-in. pendulum-type hot saw and cooling trough. At intermediate stands bad ends may be cropped off by portable crocodile shears at either end of the mill.

Sheet and Strip Production—Shepcote Lane Works

Slabs are dressed by grinding on all surfaces then cut to weight for hot-rolling into sheet bars, which are produced in a reversing hot mill.

(*Continued in page* 376)

Firth-Vickers Celebrate First 25 Years

(*Continued from page* 375)

From the bars suitable " moulds " are cut, these being hot-rolled into sheets. The " moulds " are cleaned by pickling or by Wheelabrator, hot sheet rolling being carried out by 2-high pull-over mills up to 66-in. wide, the larger mills being fitted with power-operated manipulators. After hot rolling the sheets are softened, pickled and cold rolled in 4-high mills.

The strip mill handles strip up to 12-in. wide and can roll to 10 to 48g. The department is divided into five sections, *viz.*, cold rolling, softening and descaling, slitting and cropping and packing and despatch. Six mills are provided for cold rolling, two conventional 4-high non-reversing mills, two 2-high 8-in. mills, a Sendzimir mill and a Robertson skin pass mill.

Three softening and descaling lines are installed and bright annealing facilities are available for thinner gauges of strip.

Shepcote Lane Rolling Mills Ltd.

Shepcote Lane Rolling Mills Ltd. is a subsidiary company in which Samuel Fox and Co. Ltd. have a one-third interest.

Slabs approximately 5½-in. thick and up to 40-in. wide and 120-in. long are first hot-rolled into coils. This operation is carried out initially on a 2-high reversing roughing mill, followed by a fast 4-high reversing hot Steckel mill, where strip, during passes through the rolls, is coiled in furnaces situated at either side of the mill. By this method, temperature is maintained and strip may be rolled down to 0.10-in. thick in widths of up to 41½ in. Load cells are fitted under the mill screwdown to indicate rolling load, while a gamma-ray gauge gives a continuous accurate measurement of strip thickness.

The strip is coiled on a mandrel-type up-coiler and then stacked in a storage bay to await further processing.

Two coils are then welded together to form a single coil weighing up to 5½ tons which, after softening and descaling, is cold rolled to the final gauge. The cold rolling operations are carried out on two cold-rolling mills, one being a 4-high reversing type, reducing the hot-rolled strip to approximately 0.080-in. thick. The other mill, a Sendzimir cluster type, is used to reduce the strip from approximately 0.080-in. thick to finished gauge.

The cold-rolling operation may necessitate intermediate softenings, depending upon the amount of cold reduction required. There are three softening and descaling lines, the first of these being primarily designed for dealing with strip in the hot-rolled condition, while the second is used for strip cold-rolled to an intermediate thickness. The third and final line is employed in the softening and descaling of strip cold-rolled to finished gauge. After passing through the final softening and descaling line, the coils, of width ranges 24 in. to 40 in. and thicknesses from 10 to 33 gauge, are " pinch passed " for 2B finish before despatch to the founder companies. This finish is accomplished on a 2-high mill which imparts a uniform surface quality to the strip.

All bays of the building in which this plant is housed are of standardized dimensions, the width of bay being 70 ft. and so constructed as to be capable of extending in all directions.

Sheet Warehouse

This warehouse, which is adjacent to Shepcote Lane Rolling Mills Ltd., is owned exclusively by Firth-Vickers Stainless Steels Ltd. Coils of wide strip are obtained from Shepcote Lane Rolling Mills Ltd. and are further processed into the form of finished sheets. The building is of interesting design, being 300 ft. long by 200 ft. wide and with only two columns supporting the roof, the object being to give uninterrupted floor space to facilitate movement of material to each successive operation. The flow of work is from the end of the warehouse where the coils are received from Shepcote Lane Rolling Mills to the opposite end where the finished material is despatched.

The coil of strip is fed into a continuous cut-up line which draws the strip from the coil, flattens, and shears it into sheet lengths. The sheet lengths are then passed down a shearing line where sides and ends are sheared square and true to each other. There are also specially designed shears for cutting sheets into small blanks and alternative methods of flattening by stretching and by roller levelling. The sheets pass through various stages of inspection before being finally weighed and packed.

As there has also been a very considerable increase in demand for " Staybrite " steel in the form of strip, wherever possible advantage is taken of the bulk rolling facilities of Shepcote Lane Rolling Mills, and equipment has been installed in the warehouse capable of dealing with full weight coils. Coils of the maximum appropriate width are first slit into narrower strips, each of which can, if required, be re-slit into still smaller multiple widths. Special equipment has been provided to enable both surfaces of this strip material to be inspected, in the first place as it arrives from the Rolling Mills, and finally after slitting.

Anniversary Luncheon

To celebrate the company's silver jubilee, a luncheon was held at the Cutler's Hall, Sheffield, on April 7. An exhibition showing the wide range of uses for stainless steel with exhibits from manufacturers throughout the world was also on show.

In a speech of welcome to the guests, Dr. C. Sykes, F.R.S., chairman of Firth-Vickers, said that in its first year of operation, in 1935, the company produced 6,000 tons of stainless steel; the capacity today, however, was 40,000 tons per annum.

The original Shepcote Lane scheme started at an estimated cost of £0.875m. and finished at just under £3m. The first mill turned round in 1952 and the plant finally got into its stride in 1954.

The cold mills were designed to produce sheets equivalent to 15,000 ingot tons, but the hot-mill capacity as installed was 100,000 tons. The idea behind having such a large capacity hot mill was simply that it was possible to increase output capacity merely by adding cold mills and descaling lines.

The layout was then modified so that the Steckel principle using hot boxes could be incorporated if required.

By 1954, when the plant was working to planned capacity although the output of sheets was 50 per cent higher than the original planned figure, it was clear that capacity all round was inadequate. It was decided to proceed with the installation of the Steckel plant at the main Shepcote Lane plant, to instal a new 12-in. strip mill with an annual output of 4,000 tons of strip and to replace the bulk of the old bar mills by modern mills, with a 50 per cent increase in capacity.

On the wide strip mill after modification it was possible to build up a coil weighing 10/12,000 lb. with only one weld.

Towards the end of last year a new scheme for a further increase in capacity at Shepcote Lane of 70 per cent was suggested. This had been approved and should come into commission in 1961/62.

On the foundry side a new static foundry had been built at Blackheath and modernization of the centri-spinning foundry was proceeding on a new site at Shepcote Lane.

POLISHING AT "LEISURE"

Typical polishing operation at Leisure Kitchen Equipment

PRODUCTION at Leisure Kitchen Equipment's Long Eaton works is currently running at a high rate, a substantial output of stainless steel and enamelled steel sinks and other fitments being produced in addition to a large volume of other kitchen furniture for domestic, hospital, catering and industrial use. While production consists of a very diversified range, significant features of manufacture are the extremely clean and orderly working conditions, the measures taken to obtain the maximum production from a given floor area and the quality control philosophy which is concerned not only with the inspection of products for the most minute flaws but also with the prevention of the causes of defects before these develop.

The firm, which is a member of The Allied Ironfounders' Group, has recently brought into production a new pressing works at Meadow Lane on a site close to the existing works at which the finishing and assembly work is concentrated. The Meadow Lane plant is accommodated on two floors, with the presses sited on the 1st floor. The stresses from these units are accommodated by mass reinforced concrete foundations, independent of the main structure, this being founded on bored concrete piles to a depth of 28 ft. below ground level.

Housed on this floor are all the major presses, which range in capacity from 1,100-ton hydraulic double-acting units to 350-ton mechanical presses. These are served by two overhead conveyor systems designed by the firm's engineering department and 10-ton overhead travelling presses. The major conveyor which serves the presses and circuits the plant is one-third of a mile in length while the secondary system, for handling the pressings through the degreasing plant, is 250 ft. in length. Degreasing is carried out after the first stage of pressing and is effected in a trichlorethylene vapour chamber followed by a spray and drying. After degreasing stainless-steel pressings are annealed at a temperature of 1,000° C. to overcome work hardening and are pickled in hydrofluoric acid solution, these operations being carried out in annexe to the main shop. On the ground floor are accommodated the machine-tool room, in which all the press tools are made, the sheet-metal stores and the preliminary grinding section.

Seam Welding

A certain amount of seam welding is carried out by continuous seam and stitch welding methods where bowls of non-standard shapes require to be welded to the steel surrounding board. The preweld surfaces of the bowls are prepared for welding by Hicycle sanders in a shop adjacent to the annealing annexe, current being drawn from a A.E.I. 5-kW. frequency changer. Two further A.E.I. 10kW. frequency changers serve the Hicycle polishers which are employed in the first-stage polishing room on the ground floor.

At main works, the pressings for enamelling are taken successively through the shot blasting plant and the grip-coat dip baths. After firing of the first coat, the colour coats are fused in a 1,350-kW. continuous furnace. The stainless-steel pressings are polished in a number of stages using Consolidated Pneumatic Hicycle high-frequency electric sanders and buffers, a total of some 130 of these tools being in use throughout the works, over 90 of these being used in the polishing shop. The most generally used model is the 401G-5,000 buffer with 6 in. diameter mops. These tools are operating from a 200 cycle 3-phase circuit at 125 volts, or to earth 72 volts. A characteristic of the induction motor is a speed slip between free loaded conditions of only 10 per cent as compared with the 50 per cent slip of a universal motor and a speed drop of 25 to 30 per cent of a compressed air motor. This characteristic, apart from such aspects as a higher rate of metal removal, ease of handling and economy in power consumption, is responsible for the high, constant spindle speeds which are necessary to obtain a deep polish.

Use of Hicycle Grinders

A point of interest is that 6 in. diameter mops are used with the 401-G-5,000 Hicycle grinders. The machine was specially developed for this speed for polishing of stainless steel where 6 in. mops are preferred. This speed has been most satisfactory and is preferable to the standard 6,000 r.p.m. which is too fast and is liable to cause a heat discoloration on the metal.

The sequence of polishing starts with the use of calico mops dressed with 80 grit aloxide, this being followed by further mops dressed with finer grits down to 180 bauxilite. Felt wheels, lubricated with bobbing grease and dressed with 140 grit emery are then employed, followed in turn by calico mops dressed with 240 grit emery. The final stages employ brushes in conjunction with various types of fine polishing media.

GAS AT WORK IN INDUSTRY

Many Applications Shown at London Exhibition

SOME of the many applications of gas in industry were shown in an exhibition at the Royal Horticultural Hall, Westminster recently. The exhibition, the second of its kind, was sponsored by four of the 12 Area Gas Boards and included a range of equipment, much of which was in operation. The demand for gas is apparently high in industries where processes are continuous and precise control is essential; a central feature showed examples, in the form of models and pictures of the part gas plays in the development of modern industry.

On the heat treatment stand, British Furnaces Ltd. were exhibiting their new gas-fired shaker hearth furnace, which is capable of giving light case treatment or surface carbon correction. The furnace is robustly fabricated in mild steel, its shape being essentially cylindrical, with integral support legs and base for the shaker mechanism. It is lined with hot-face insulation brick and backed up by diatomaceous earth, designed to give the minimum thermal capacity and minimum radiation losses. The burner equipment was made up of 10 low-pressure, tangentially disposed tunnel burners of the new short flame design and mounted in removable H.R.I. carriers, each with a premix pilot burner for safety when lighting up. The work to be treated is introduced to the furnace by means of a tray activated by a 4 in. bore air cylinder which has separate forward and backward speed adjustments and a frequency adjustment. Shown in conjunction with the furnace was the MRX atmosphere generator. The gas atmosphere is generated by the endothermic reaction of air-gas mixture, heated externally in a tube containing a catalyst, and the atmosphere so produced is suitable for bright annealing and clean hardening of low and medium carbon steels without scale or decarburization.

A rotary retort carburizing and carbo-nitriding furnace was also on show on this stand exhibited by Thermic Equipment and Engineering Co. Ltd. The furnace was having its first appearance at an exhibition and was shown complete with all flow gauges, giving process control for clean hardening, gas carburizing or carbo-nitriding. The makers claim that the unit provides a low cost controlled atmosphere plant for treating steel components in batches, combining precise metallurgical control with high output. A special feature of the unit is that it does not require a separate generator to control case characteristics.

Dowson and Mason Ltd. exhibited a gas-fired continuous wire mesh conveyor muffle furnace which can be used in connexion with the annealing and heat treatment of small pressings and similar components as well as brazing and sintering. Capable of an output of 80 lb. per hour at a temperature of 800° C., the furnace is primarily intended for heat treatment in a prepared atmosphere and is used, for example, in the manufacture of radio valves. One of the particular advantages in using gas as a fuel in this furnace is that, as a result of the low sulphur content of town gas, the life of the muffle is greatly increased.

Vitreous Enamelling

Another furnace having its first showing at an exhibition, was the small continuous furnace, fired by incandescent tubes and used for the vitreous enamelling of badges and similiar small enamelled ware, shown by The Incandescent Heat Co. Ltd. The outstanding feature of the furnace is the use of Jetubes, high recirculation tubes developed by the company. A mixture of gas and air is burned in a refractory-lined section of the tube and products of combustion leave this chamber at high velocity through a nozzle, entrain the hot gases already recirculating in the body of the tube, so building up recirculation. The system gives even heating throughout the whole tube and the makers claim very high heat transfer rates and a much improved flexibility, working at temperatures between 550 and 830° C. This type of furnace is already being used for heating tinplate strip in the high speed, continuous annealing line at the Velindre Works of The Steel Company of Wales Ltd.

On the flame heat treatment stand, a cutting machine which can read pencil line drawings automatically without physical contact between tracer and drawing, was displayed by Hancock and Co. Ltd. The Hancoline machine has been constructed to give a high degree of accuracy over the cutting area. Of the dual carriage type, the top and bottom carriages are of box construction giving rigid protection to the moving parts and electrical equipment. The bottom carriage runs on heavy section rails ground to a tolerance of 0.001 in. The sides of the main rails are ground to a similar tolerance and are engaged by ball-bearing check rollers. A live axle couples one pair of bottom carriage wheels and ensures precise longitudinal motion. Check rollers are mounted where necessary on eccentric bushes to make adjustment of squareness easy. The burner equipment is the latest non-back-firing F. C. type with flexible tubing coupling the burner head to the trimming valves, and provision is made to enable additional burner assemblies to be fitted without any structural modification of the machine. Probably the most important item in this machine is the scanning head which scans the line drawn on a specially treated piece of paper, to offset any variation in the drawn dimensions due to atmosphere and temperature effects on the paper, and sends photocell signals to the control cabinet. The amplified signals are then passed to the servo motor geared to the scanning head, which is free to rotate and equipped with a small spotlight for location and setting purposes. Another useful feature which adds to the simplicity of this system, is a prismatic device, an integral part of the scanning head. A calibrated dial is provided, enabling the width of cut to be made automatically by the machine. Thus the drawing required is the same size as the workpiece and the laborious task of making drawings specially dimensioned to compensate for width of cut is eliminated. To help the new user familiarize himself with this machine a detailed and copiously illustrated instruction book giving comprehensive information on all aspects of operation and maintenance, is supplied.

Flame Hardening

An exhibit that had a great deal of attention paid to it during demonstrations was the Peddinghaus fully automatic oxy-town-gas gear hardening plant, utilizing the recently perfected spin hardening method. The complete cycle of operations is preset and ensures consistent and accurate results. It is available for

(*Continued in page* 379)

MESSEL MEDALLIST FOR 1960

THE Messel Medal, which is the senior award of the Society of Chemical Industry and is awarded every two years in gold, will be presented to the medallist for 1960, The Rt. Hon. The Viscount Chandos, D.S.O., M.C., in Bristol on Wednesday, July 6 next during the Annual Meeting of the Society. The Messel Medal is awarded for meritorious distinction in Science, Literature, Industry or Public Affairs and previous recipients include: Sir Henry Tizard, Lord Cherwell, O.M., Sir Alexander Fleck and The Rt. Hon. C.D. Howe.

ENGLISH ELECTRIC TO PROVIDE ELECTRICAL EQUIPMENT FOR COLVILLES' MILLS

A COMPREHENSIVE contract for all the electrical equipment in three steel rolling mills has been awarded to the English Electric Co. Ltd. by Colvilles Ltd., for their new Ravenscraig plant, near Motherwell, the biggest industrial project ever undertaken in Scotland.

All the equipment will be engineered by English Electric's Metal Industries Division and mainly manufactured at the company's Stafford works. Manufacturing will also be done at Bradford, Liverpool and Kidsgrove. Delivery will be completed by the end of 1961.

Most important of the three mills is the semi-continuous hot strip mill. Besides light plate this will produce hot coiled strip which will be further rolled into sheet steel for cars and domestic appliances. It is hoped that with the building of the Ravenscraig plant these "consumer durable" industries will be encouraged to establish themselves in Scotland, where up to now the emphasis has been on heavy industries such as shipbuilding and boiler making. Some of the mechanical equipment for the plant will be manufactured in Scotland.

The strip mill will be fed from the universal roughing and slabbing mills, both of which are of the hot reversing type with twin-drive motors. On the slabbing mill these will have a total of 14,300 h.p. and on the roughing mill 10,500 h.p.

For distribution of power within the plant the company is also supplying seventeen 1,500 M.V.A. 33 kV. air-blast circuit-breakers. These will also be manufactured in Stafford, by the Switchgear Division.

Gas at Work in Industry

(*Continued from page* 378)

hardening small gears and pinions up to 5 ft. diameter and 10-in. tooth width, to a predetermined depth below the roots of the teeth, and the makers claim great increases in strength together with a remarkable reduction in distortion. The basis of this process is the milliscope pyrometer which can follow the temperature rises during a much shortened heating time, without any appreciable time lag. It uses the principle of the incandescent lamp pyrometer by comparing the radiations of two bodies inside a certain wave band, one issuing from the object and the other from a calibrated incandescent lamp. The receiving element consists of a lead sulphide cell. The floor to floor time for a small spur gear of 8½-in. diameter and 4-in. tooth width is 4½ minutes and on quenching the gear may be handled manually. The sole representatives for England are Surfard Ltd.

A new conveyorized pre-heating and fusing plant of particular interest to manufacturing jewellers, enamellers and badge manufacturers was displayed by Stewart, Gill and Co. Ltd. The design enables accurate control of time and temperature to be obtained and virtually eliminates trial and error methods.

Gas-heated panel units for infra-red radiation were shown by Parkinson Cowan Industrial Products. They can be used in the vertical position or inclined up to 45 deg. in either direction, and an average panel temperature of 650 deg. is available over the whole radiant area of 4½ sq. ft. The ease of installation is claimed a feature of these tunnel units, each of which is complete in itself and in most cases no additional frameworks or casings are necessary. The burners fitted are the neat flame type and can be inspected while in operation and be removed for cleaning or adjustment from the rear of the unit without disturbing the assembly. The conveyor most used with these panels is of the monorail type which suspends the work to be treated and is speed adjusted according to the process involved.

Air blast tunnel burners and a gas-fired industrial batch oven formed the exhibits of Barlow-Whitney Ltd. The oven was of the tray loading type, with air circulation with circular and slot discharge type burners, electrically ignited and with "Ether" flame failure equipment. An interesting feature of the oven was a safety relief panel of aluminium foil which blows out when the pressure builds up to a predetermined maximum.

The RJH "Hippo" wet bandfacer has recently been introduced into the badge-making trade where it is being used with some success for polishing ceramic-filled badges and similar products. The machine was shown by The RJH Tool and Equipment Co. Ltd. and it employs special waterproofed abrasive bands on to which a fine jet of water is sprayed, preventing the filling cracking. This machine can be applied in the fields of badge polishing as well as any ceramic, glass or plastic grinding operation where heat generation must be kept.

An interesting demonstration was presented by Fattorini and Sons Ltd., who produce these badges and lapel emblems. Visitors were able to watch the enamelling and finishing of metal badges which included the cleaning and bright dipping of stampings, the application of the enamel, its subsequent firing and glazing, the removal of excess enamel by linishing, and assembly.

BRITAIN'S SPACE AGE INDUSTRIES ON SHOW

TWICE the size of its predecessors in conception, floor space and the number of exhibitors, the third international Instruments, Electronics and Automation Exhibition will be held at Olympia, London, from Monday, May 23 to Saturday, May 28 inclusive.

Nearly 500 firms, 100 from overseas, will show the kind of equipment on which much of the surge of scientific discovery and industrial output in the '50's was hinged—and on which both are counting for the years ahead.

H.R.H. The Duke of Edinburgh has graciously consented to become Patron of the Exhibition and the industries taking part regard it as a signal honour that he should do so.

"Applications of Plastic-coated Steel Sheet and Strip"

Reference (4) in the above article published in the February, 1960, issue of SHEET METAL INDUSTRIES should read:

(4) Park, Ford R. "Magnetic-Force—the new joining method for vinyl-clad steel." *Product Engineering*, 1958, September 15, pp. 82-85.

SEMI-CONDUCTOR RECTIFIERS FOR TINPLATE MANUFACTURE

THE Westinghouse Brake and Signal Co. have secured the rectifier contracts for two more high-speed tinning lines requiring a total of 430,000 amp. of direct current, following the successful operation of their equipment at the Velindre Works of the Steel Company of Wales, where direct water-cooled selenium rectifiers provide a total of 450,000 amp. on three continuous electrotinning lines, and a later installation at Cornigliano Spa at Genoa, providing 110,000 amp.

The first of the new contracts is for Richard Thomas and Baldwins Ltd. at Ebbw Vale. The electrical equipment includes 220,000 amp. of water-cooled germanium rectifiers, together with the transformer stepping down from the 11 kV. systems. transducers to control the plating current and automatic controls to provide plating current exactly proportioned to the speed of the line, which can run up to 1,500 ft. per min., enabling the thickness of the tinplate to be accurately controlled.

The second contract is for a 2,000 ft. per min. tinning line at the Port Kembla Works of Australian Iron and Steel Ltd.; this line will require 330,000 amp. ultimately but only 210,000 amp. in the initial stages. Silicon has been selected as the best rectifier to meet the temperature prevailing, the rectifiers being air cooled in a recirculating system where the heat is absorbed by sea-water heat exchangers.

The silicon diodes, transformer, transducers and control system are being made at the Chippenham Works of the Westinghouse Brake and Signal Co. Ltd., who are supplying this equipment to their Australian subsidiary, McKenzie and Holland Pty. Ltd. who are building the rest of the equipment.

BRITISH FIRM WINS LARGE ORDER FROM THAILAND

ONE of Britain's biggest single export orders for drum-making machinery has been secured by the Birkenhead firm of Moon Brothers Ltd.

The machines and ancillary equipment for the production of 200-litre oil drums will be shipped from Merseyside to Thailand to form part of a new oil refinery there. The first machines will be ready in October and, when completed, the order will reach a substantial value.

The machinery includes eight power-presses, guillotine shears, drum sheet-edge grinder, drum roll, spot and seam welder, double-ended drum flanger, drum corrugator, drum bead expander and semi-automatic round seamers. Additional equipment for open-top drums is also being supplied and the ancillary equipment includes a paint spray booth and drying oven and a selection of machine tools and hand tools to equip a complete maintenance shop.

A service engineer from Moon Brothers will travel to Thailand to supervise the setting up of the machines and to train operators.

The order was secured by Moon Brothers' representatives in Bangkok, Gutwirth and Sons (M) Ltd. It is the third complete plant which the firm has supplied to Thailand. As the largest manufacturers of drum-making equipment in Britain, Moon Brothers has exported to almost every country in the world and home sales supply every single drum manufacturer in the U.K.

COIL ANNEALING AT SPENCER WORKS

THE Incandescent Heat Co. Ltd., Smethwick, has been awarded a major contract for the new Spencer steelworks of Richard Thomas and Baldwins Ltd. at Llanwern, near Newport, Mon. The contract is for coil annealing plant with an output of 16,500 tons of 60-in. wide strip a week (nearly 100 tons an hour). In all, 30 furnaces will be supplied, of single and four-stack designs, together with furnace bases, forced cooling hoods and other ancillary equipment. The furnaces are the well-known Incandescent radiant-bowl fired type, such as have been supplied to leading steelworks in Britain and abroad.

The complete contract, which is worth more than £1¼ millions, is believed to be the largest single order for steel sheet annealing plant ever placed in Great Britain.

Research Scholarship in Application of Aluminium

PROVIDED that suitable candidates present themselves, the Council of the Institution of Mechanical Engineers propose to award in 1960 a Research Scholarship in the Application of Aluminium in Mechanical Engineering; the Scholarship, which is being donated by the Aluminium Development Association, is valued at £650 per annum and will be tenable for two years, with the possibility of extension for a third year.

The object of the Scholarship is to enable the holder to pursue an approved programme of research in the application of aluminium in mechanical engineering.

Candidates, who must be British-born subjects, should normally be not less than 23 years of age and must have obtained an approved engineering degree or have satisfied the Institution's examination requirements for Graduate Membership by some other means. They should preferably have had not less than 18 months of practical training in works.

Application forms and a copy of the conditions of award may be obtained from the Secretary of the Institution, to whom completed application forms should be returned by not later than May 11, 1960.

OXYGEN STEELMAKING PLANT TO BE INSTALLED AT CONSETT

THE new steelmaking plant to be installed by Consett Iron Company Ltd. as part of their current development plan will be the first plant in the world to use both the L.D. and the Kaldo oxygen steelmaking processes.

The distinction of being the first British engineering company to receive orders for L.D. or Kaldo Converters goes to Head Wrightson Iron and Steel Works Engineering, a subsidiary of Head Wrightson and Co. Ltd., who are to build two 100-ton L.D. units and two 100-ton Kaldo units.

This plant is expected to go into production at the end of 1961 and is designed to produce an additional annual output of about 750,000 tons.

BULK LIQUID PROPANE

Distribution and Service Facilities Now Available

DISTRIBUTION of bulk liquid propane, supported by free technical service and maintenance, is among the latest advanced facilities offered by British Oxygen Gases Ltd., to large industrial customers throughout the United Kingdom. Bulk holding tanks, enabling liquid propane to be stored without loss, can now be installed on a free loan basis at customers' works. Already, the new system is in use in steelworks, shipbuilding yards, scrap, demolition and shipbreaking yards, and engineering works.

Industrial customers using large quantities of propane from cylinders are faced with problems of excessive cylinder handling and possible loss of factory floor and yard space. To overcome these difficulties, B.O.G., can offer either cylinder manifolds and pipelines with individual outlet points, or for the large consumers, bulk storage tanks and pipelines. Simplicity and convenience in handling and floor space, and economies in price, make the bulk propane system readily appreciated by industry.

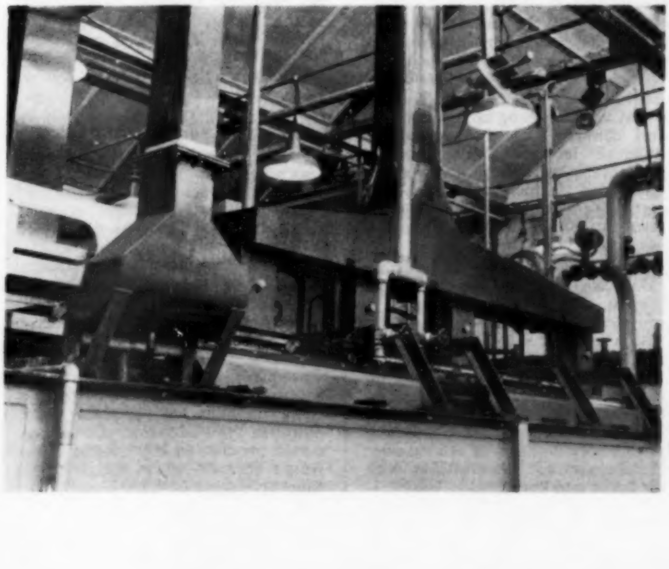
Bulk propane holding tanks are offered to customers on a free loan basis. Large industrial users can change quickly from cylinder supply to the bulk system and enjoy more advantageous prices, with little or no capital outlay for the new installation.

The new bulk propane installations are maintained free of charge by specialist personnel. Regular visits are made to customers in all districts. Speed and efficiency are safeguarded, and repairs where necessary are immediate and without charge.

This exceptional service and the technical advice offered by British Oxygen Gases to users of the liquid propane bulk installations marks a further stage in the company's pioneer development of the most economical methods for the distribution of industrial gases.

FUME EXTRACTION PLANT

A.C. PLASTIC INDUSTRIES LTD., LONDON, have recently fabricated and installed a fume extraction plant made from Cobex rigid vinyl, produced by BX Plastics Ltd. It is part of a new fully automatic plating plant used by Gillette Industries Ltd. at their Isleworth Works. Because of its excellent corrosion-resistant properties, Cobex is used extensively in combating corrosion in all fields of industry.



Fabrication Exhibition

A WIDE range of sheet-metal engineering and fabrication work will be on view at an exhibition of products presented by James H. Randall and Son Ltd. the engineers of Paddington Green, London. This exhibition will be held in the new extension to their London works from May 2 to 6. Since 1851 Randalls have specialized in precision work and medium-size production runs.

Model Engineering Ltd., one of the subsidiary companies of J. H. Randall and Son Ltd., will be exhibiting precision machined parts manufactured for varying industries.

GAS ALLOYING AND ANNEALING

American Corporation Enters European Field

THE Lee Wilson Engineering Company, Cleveland, U.S.A., and its European licensees have joined to form a new corporation to co-ordinate sales and manufacturing facilities for open-coil gas alloying and annealing in both the European Common Market and Free Trade Area.

To be known as Lee Wilson Engineering Company, S.A., the new office will be headquartered in Fribourg, Switzerland. It will function through present licensees in providing sales and engineering information and special mechanical coiling parts of the process. These licensees are Heurtey in Belgium, France and Italy, Incandescent Heat Co. Ltd. in England and Ofag in Germany.

The new office will be managed by Vincent J. Gibbons, formerly chief of the technical division of the Armco International Corporation in Europe. In that capacity he handled contracts with Armco European licensees and acted as liaison agent between Armco's overseas associates and headquarters activities, notably in supplying steel plant licensees with the "know-how" to manufacture commodity and special steels.

Mr. Gibbons graduated from Ohio State University in 1937 with a degree in Metallurgical Engineering. Upon graduation he became a technical correspondent for Armco International. Following this he became a metallurgist for the same division, which was followed by

(*Continued in page* 382)

Gas Alloying

(*Continued from page* 381)

ordnance work and navy service. In December, 1946, he resumed as technical correspondent and in July, 1948, became service engineer for the international division. On February 1, 1955, he was made chief of the international technical division, a position he held until his resignation to head up the new Lee Wilson office.

SERVICE DEPOT FOR FORK TRUCKS

A NEW Service Depot for London and the Home Counties has been opened at Barking, Essex, by the British Materials Handling Division of The Yale and Towne Manufacturing Company. Providing an immediate spare parts' service to all Yale industrial truck users, the depot is well equipped and is staffed by fitters specially trained for carrying out routine servicing and component repairs.

The full address of the depot, which is open from 8 a.m. to 6 p.m. on weekdays and from 8 a.m. to 12 noon on Saturdays, is :

The Yale and Towne Service Depot,
Ripple Road South,
Barking, Essex.
(Telephone : DOMinion 5945).

STAINLESS-STEEL FABRICATORS AND STEEL STOCKISTS MERGE

METAL PROPELLERS LTD., of Croydon, Surrey, who specialize in the design and fabrication of plant in stainless steel and other similar alloys, have acquired The Standard Steel Co. (1929) Ltd., who occupy adjoining premises on Purley Way, Croydon.

The Standard Steel Co. are steel stockists and constructional and mechanical engineers who undertake the supply and erection of structural steelwork of all types. Steelwork for the new Croydon Technical College is one major contract recently completed.

Mr. C. Colley, managing director of Metal Propellers, has been appointed managing director of Standard Steel. Mr. D. R. Morgan, who will continue as a director of Standard Steel, has been appointed general manager of that company, and a director of Metal Propellers.

NEW VACUUM FURNACE FOR BRITISH IRON AND STEEL RESEARCH ASSOCIATION

THE General Electric Co. Ltd. in association with Vacuum Industrial Applications Ltd., has received an order for the supply of a vacuum melting furnace to the British Iron and Steel Research Association for use in their Sheffield Laboratories.

The furnace has a melting capacity of 56 lb. and is to be used for research into the vacuum melting and casting of ferrous metals. The working pressure of the furnace is 1 micron Hg. and it is designed for a working temperature of 1700° C.; the charge is poured into the moulds by tilting the crucible.

The 24-in. diameter furnace is horizontal to provide ample working space and to permit easy cleaning of the inner surface. Within the chamber are dip thermocouples for temperature measurement, and also six tipping buckets for adding alloying metals to the molten charge.

The chamber is evacuated by means of a two-stage pumping system comprising a 10-in. oil booster-diffusion pump backed by a gas-ballasted rotary pump. The pumping speed of this combination is high enough to maintain the chamber pressure under conditions of severe outgassing.

The charge is induction heated and power for the furnace is supplied by a 10 kc/s motor-alternator.

STEEL PLANT ORDERS FOR HEAD WRIGHTSON

THE Head Wrightson Machine Co. Ltd., a subsidiary of Head Wrightson and Co. Ltd., have announced today that the Steel Company of Wales Ltd. have placed an order with them for the supply of a high speed cut-up line for their Abbey Works, valued at about £233,000. This line is one of the items in the new development programme designed to increase the output of steel sheets.

This order follows a previous order (for a similar cut-up line) recently completed for the same company.

This line will take coils of cold-rolled strip weighing up to 56,000 lb. and convert these into sheets of different lengths. The cutting to length is carried out at speeds of up to 700 ft. per minute. After cutting up, the sheets will be automatically sorted and piled into packs of up to 40,000 lb. in weight.

The Head Wrightson Machine Co. is also actively engaged at the present time in the building of a complete electrolytic tinning line with a number of ancillary lines, for the Ebbw Vale Works of Richard Thomas and Baldwins Ltd., a complete seamless tube mill of special design, a large number of heavy plate levellers, hot-dip tinning plant for Poland as well as a number of tube and bar drawbenches both for home and overseas.

SIMA to Hold British Scientific Instruments Exhibition in Russia

AS a result of the report to the Council by the three-man delegation of the Scientific Instrument Manufacturers' Association of Great Britain, SIMA House, Queen Anne Street, London, W.1, which went to Moscow at the beginning of November, and the support from 30 members of SIMA, an exhibition of British scientific instruments will be held in Moscow from June 16 to 26, 1960. This exhibition will be the first to be put on in Russia by a British organization of manufacturers in a specialized field. It is possible that some additional exhibitors will participate and further enquiries are still being received.

Iron and Steel Works to Close in Southern Rhodesia

RHODESIAN Iron and Steel Co. Ltd. are to close their works at Bulawayo in Southern Rhodesia where some 58 Europeans and 200 Africans are employed. The plant, which produces about 150 tons of rolled steel a month and some castings, is probably the oldest in the Federation and cannot match production costs at the company's Redcliff works which has a monthly output of 5,000 tons.

NEW COMPANIES

"Ltd." is understood, also " Private Co." Figures — Capital, Names — Directors, all unless otherwise indicated.

E. HORDON, 33, Burley Wood Lane, Leeds, 4. February 11. £1,000. *To carry on the bus. of stainless steel fabricators, etc. Directors nor named.*

J. H. AUCKLAND, St. Johns Chambers, Love Street, Chester. February 11. £1,000. *To carry on bus. of motor body builders, painters, platers, polishers, enamellers and finishers. John H. Auckland, John G. Auckland.*

MURPHY AND THOMAS, Albert Street, Birkenhead, Ches. February 11. £6,000. *To carry on the bus. of sheet metal workers. Jack B. Murphy, James A. Thomas, Ethel A. D. Murphy.*

MEADOWSIDE ENGINEERING, Cozens Lane East, Broxbourne, Herts. February 19. £6,000. *To carry on bus. of precision tool manufacturers, light engineers, etc. Cyril L. Hammett, Douglas P. Luckett.*

WILCO MANUFACTURING, 19a, Aston Street, Birmingham. February 19. £5,000. *To carry on bus. of general engineers, manufacturers of metal articles. Fredk. W. Willmott, Leonard A. Willmott.*

DEON (FABRICATING), Hendy Works, Pontardulais, Carms. February 22. £100. *To carry on the bus. of buyers and sellers and manufacturers of and dealers in sheet steel, steel rods, etc. Alexander G. Morrison, Owen J. Davies.*

BARTON STAMPINGS, 129, Conybere Street, Birmingham. February 23. £2,000. *To take over the manfrs. of non-ferrous pressings and stampings carried on by C. W. Barton, etc. Edwin J. Hancock, Clarence W. Barton.*

BRITISH TOOL AND ENGINEERING, Britool Works, Bushbury, Wolverhampton. February 23. £100. *Alfred W. Jeffs, Walter E. Evans, Thomas L. Edwards.*

E. A. HAWKINS, 106/7, Cheapside, Birmingham, 12. February 26. £1,000. *To carry on the bus. of steelmakers and ironfounders, etc. Eric A. Hawkins, Lilian A. Hawkins.*

DARWEN TOOL AND ENGINEERING, Brunswick Street Works, Darwen. February 26. £1,000. *To take over the bus. of engineers and toolmakers carried on at Brunswick Street and Norfolk Street, Darwen, etc. James Hogg, Douglas V. Sage, Teresa Hogg, Mary Sage.*

ALBERT E. HILL. March 1. £1,000. *To carry on the bus. of engineers, founders, etc. Albert E. Hill, of 217, Burnt Ash Lane, Bromley, Kent; Charles A. Brisley, Olga Hill.*

METAL PRODUCTIONS (HALIFAX), 27, Bradford Road, Brighouse. March 1. £5,000. *To carry on the bus. of manufacturers and assemblers of steel and other metal. Directors not named.*

R. D. MOORE, 1a, Andover Street, Patricroft, Eccles. March 3. £2,000. *To carry on the bus. of sheet metal workers. Wm. Watson, Robert D. Moore.*

DOMESTIC METALWORK, 14, Market Street, Highbridge. March 3. £5,000. *To carry on the bus. of engineers, etc. Eugene J. Treanor and Kathleen Treanor.*

From the Register compiled by Jordan & Sons Ltd. 16, Chancery Lane, London, W.C.2.

THE IRON AND STEEL INSTITUTE ANNUAL GENERAL MEETING

Election of President

AT the annual general meeting of The Iron and Steel Institute, to be held at the Royal Commonwealth Society, Northumberland Avenue, London, W.C.1, on the morning of May 3, 1960, Mr. W. F. Cartwright will take over from Mr. William Barr as president of the Institute for 1960-1.

William Frederick Cartwright was born in 1906 and commenced his technical training in 1925 at the Swindon works of the Great Western Railway. He joined Guest Keen and Nettlefolds Ltd. in 1928 at their Dowlais Works and in 1931 was appointed assistant works manager at the Port Talbot Works of Guest Keen Baldwins Iron and Steel Co. Ltd. Four years later he became technical assistant to the managing director, a position he held until 1940, when he was appointed chief engineer, and at the same time elected to the board of the company; three years later he became general manager of the Margam and Port Talbot Works.

When the Steel Company of Wales Ltd. was formed in 1949, Mr. Cartwright was elected a director and became general manager of the Steel Division; he became assistant managing director of the company in 1954.

A member of the Institute since 1936, Mr. Cartwright was the first chairman of the engineering committee following its establishment in 1946. He was elected a member of council in the same year, and became a vice-president in 1955. He was awarded the Institute's highest honour, the Bessemer Gold Medal, in 1958.

Awards

THE Council of The Iron and Steel Institute has announced the award of the following medals and prizes :—

Bessemer Gold Medal for 1960

To Professor Dr. HERMANN SCHENCK, Director of the Institut für Eisenhüttenwesen, Rheinische-Westfälische Technische Hochschule, Aachen, Germany and President of the Verein deutscher Eisenhüttenleute.

Sir Robert Hadfield Medal for 1960

To Dr. J. C. HUDSON, Head of the Corrosion Section, Chemistry Department, British Iron and Steel Research Association.

Andrew Carnegie Silver Medal for 1959

To Dr. P. R. V. EVANS, Research Department, Metropolitan-Vickers Electrical Co. Ltd., Manchester, for a paper on " The effect of rolling unstable austenitic 0.76 per cent carbon steel at 220-300° C." (Journal, 1959, January, p. 34); his co-author, Professor Hugh O'Neill was not eligible for an award.

Williams Prize for 1959

To Mr. I. M. D. HALLIDAY, Research and Development Department, The United Steel Companies Ltd., Rotherham, for a paper on " Continuous casting at Barrow " (Journal, 1959, February, p. 121).

These awards will be made at the Institute's annual general meeting at the Royal Commonwealth Society, Northumberland Avenue, London, W.C.1, on the morning of Tuesday, May 3, 1960.

Change of Telephone Numbers

THE telephone number of the Service Department of **Research and Control Instruments Ltd.**, 49, Temperley Road, Balham, London, S.W.12, has been changed to Battersea 8641 (four lines).

The telephone number of the **Gas Council** has been changed to Belgravia 4321.

APPOINTMENTS and STAFF CHANGES

Left.—**G. B. G. POTTER**
(Smith's Aviation)

Right.—**BJORN ROSEN**
(Sandvik Swedish Steels Ltd.)

As a result of the offer by **Albright and Wilson Ltd.** for the capital of **A. Boake, Roberts and Co. (Holding) Ltd.** having become unconditional, Mr. F. G. Pentecost, chairman of A. Boake, Roberts and Co. (Holding) Ltd., has been appointed a director of Albright and Wilson Ltd.

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Captain H. Leighton Davies, assistant managing director of the **Steel Company of Wales Ltd.** is to succeed Lord Monckton as chairman of the **Industrial Welfare Society** and the Council.

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The **Rockwell Machine Tool Co. Ltd.,** member of the Coventry Gauge and Tool Co. Ltd. Group, announce that Mr. H. P. Potts has accepted an invitation to join the board of the company.

* * *

Mr. P. O. Strandell has been appointed consultant to **Firth Cleveland Steel Strip Ltd.** Mr. Strandell has many years of experience in the production and heat-treatment of high-carbon steel strip in Sweden.

* * *

C. and L. Hill Ltd. announce the reorganization of the executive management. Mr. E. J. Boag, who was previously works manager of the Phosphor Bronze Co. Ltd., has been appointed director and general manager of C. and L. Hill Ltd. and its subsidiaries. Mr. W. A. Bannister becomes sales director and Mr. L. E. Morris continues as works director.

* * *

Mr. W. J. Wyers, F.R.S.A., Grad. I. Prod. E. has been appointed products assistant chief designer to the research and development department of **Rubery Owen and Co. Ltd.,** Darlaston, the parent company of the Owen organization. He will be responsible for the complete design, prototype build and test and the production on a number of the group products.

Mr. Leslie H. Davis, A.M.I. Mech.E., lubricants supervisor and assistant to Mr. A. E. McAulay, B.Sc., lubricants manager, **Scottish Oils and Shell-Mex Ltd.,** has been appointed lubricants manager, Southern Division, **Shell-Mex and B.P. Ltd.,** Southampton.

Mr. W. W. Harrow, lubricants supervisor, Dundee Branch, succeeds Mr. Davis as lubricants supervisor and assistant to Mr. McAulay, Scottish Oils and Shell-Mex Ltd.

Mr. W. J. Gooding has retired as lubricants manager, Southern Division, Shell-Mex and B.P. Ltd.

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Landmaster Ltd., Hucknall, Nottingham, a member of the Firth Cleveland Group, announce a number of important appointments. Mr. A. Booth (general manager), Mr. J. Howard (export sales director), Mr. F. Bedworth (home sales director), Mr. E. W. Lee (technical director), Mr. H. T. Jones (works director) and Mr. R. Wijewardene (director—South-East Asia), all of whom have served as executive directors for some years, have now been appointed to the main board.

Additionally, Mr. A. Booth and Mr. J. Howard are appointed joint managing directors of the company. Mr. Booth will be responsible for administration of the Hucknall factories as well as for all engineering matters. Mr. Howard will control home and export sales, publicity and associated subjects.

* * *

Mr. David A. Jenkins, deputy coke ovens manager at the Ebbw Vale Works of **Richard Thomas and Baldwins Ltd.** since May, 1958, has been appointed manager of the coke ovens at the company's Redbourn Works, Scunthorpe, Lincolnshire. He succeeds Mr. R. Raby, who has been appointed coke ovens manager at the Spencer Works, now being built at Llanwern, near Newport, Mon.

Mr. G. B. G. Potter, B.Sc., M.I.Mech.E., F.R.Ae.S., has been appointed managing director of the Aviation, Marine and Industrial Divisions of **S. Smith and Sons (England) Ltd.** which have been co-ordinated as Smiths Aviation Research and Engineering.

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Mr. Bjorn Rosen has recently arrived in this country to take up an appointment as managing director of **Sandvik Swedish Steels Ltd.,** Halesowen, Birmingham.

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Mr. John Marshall Shaw has been appointed a director of **Arthur Lee and Sons Ltd.**

Mr. George Wilton Lee and Mr. Arthur Marshall Lee, who are directors of the company, have joined the board of **John Shaw Ltd.**

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D. F. Tayler and Co. Ltd. have appointed Mr. G. Flood and Mr. H. Mole as directors of the company.

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Mr. Norman Readman, managing director of The Consolidated Pneumatic Tool Co. Ltd., London, makers of compressors and compressed air equipment, a wholly owned subsidiary company of **Chicago Pneumatic Tool Co., New York,** has been elected to the board of the New York parent company.

Mr. Readman remains managing director of the Consolidated Pneumatic Co. Ltd. in London, and from there continues to be responsible for all Chicago Pneumatic's operations throughout the world, outside of the Western Hemisphere.

Mr. F. E. Wilson has been appointed managing director of **B. Elliott (Machinery) Ltd.,** of Victoria Works, Willesden, London, N.W.10, and also joins the boards of **Victoria Machine Tool Co. Ltd.,** and **Cardiff Lathe and Tool Works Ltd.**

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Mr. C. E. Cunliffe has been appointed publicity manager of **Desoutter Bros Ltd.,** The Hyde, Hendon, N.W.9.

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The **Board of Trade** have announced that the following changes have been made in senior appointments: Mr. G. H. Andrew, C.B., at present Second Secretary (General) to become Second Secretary (Overseas) in succession to Sir Edgar Cohen, and Mr. J. Leckie, C.B., to become Second Secretary (General) in succession to Mr. Andrew. Mr. G. Andrew, who is 49, joined the Board of Trade in 1931 as an assistant examiner in the Patent Office, was transferred to Headquarters in 1938 and promoted to Assistant Secretary in 1945, Under-Secretary in 1952 and Second Secretary in 1955. Mr. J. Leckie joined the Board of Trade from Customs and Excise in 1940 and has been the Board's Principal Establishment Officer since 1958; his appointment follows the appointment of Sir Edgar Cohen as head of the Permanent Delegation to the European Free Trade Association and the General Agreement on Tariffs and Trade.

* * *

Mr. K. Fearnside, M.A. (Cantab), A.M.I.E.E., A.F.R.Ae.S. of **Smiths Aircraft Instruments Ltd.** has been appointed director of research and engineering of that company and made directly responsible to Mr. Potter for Smiths Aircraft Instruments Ltd.'s research and engineering. Mr. Roberts, who remains technical director of Smiths Aircraft Instruments Ltd., will assist Mr. Fearnside in his new appointment.

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Mr. Roy Walker has recently joined **Kelvin and Hughes (Industrial) Ltd.** as a specialist representative for North Wales, South, East and West Ridings of Yorkshire and the northern parts of Lincolnshire and Derbyshire. He had been a metallurgist with the U.K.A.E. at Windscale before joining Kelvin and Hughes and will now augment a field force of specialist representatives who are available for consultation and demonstration of non-destructive testing equipment, electronic instruments and high speed recording equipment. These representatives are strategically sited throughout the country to provide a consultative service for industry in their areas.

* * *

Edgar Allen and Co. Ltd., Sheffield, have appointed Mr. W. H. Everard as deputy general manager of the foundry division, with Mr. J. M. T. Levesley as his assistant.

Mr. Everard was appointed to the boards of Park View Steel Works, Ltd., Sheffield, and Aciéries d'Hirson, France, subsidiary companies of Edgar Allen and Co. Ltd., earlier this year.

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The Minister of Power has appointed Sir Thomas Williamson, C.B.E., J.P., and Mr. Harry Douglass to be part-time members of the **Iron and Steel Board** with effect from June 1, 1960, in place of Sir Andrew Naesmith, C.B.E., J.P., and Mr. J. Owen whose appointments expire on May 31, 1960.

* * *

Mr. E. N. Griffith, C.I.B.A.E., has been elected vice-president of the **British Engineers' Association** after having served on the Governing Council of the B.E.A. for the past 10 years as the representative of the Agricultural Engineers' Association, of which association he was president from 1948 to 1954.

Mr. Griffith is the chairman and joint managing director of Rotary Hoes Ltd., and a governor of the National College of Agricultural Engineering.

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British Insulated Callender's Cables Ltd. announce the formation of a new company, **Telcon Metals Ltd.** from April 1, 1960. This company, centred at Crawley, has assumed responsibility for all the activities of the Metals Division of The Telegraph Construction and Maintenance Co. Ltd. These cover the manufacture of the well-known Telcon magnetic materials and other special alloys in the electrical and engineering industries and also the advanced metallurgical operations associated therewith.

The board of directors of the new company will consist of: Mr. W. C. Handley, B.Sc. (Tech.), M.I.E.E., chairman; Mr. W. F. Randall, B.Sc.(Eng., M.I.E.E., F.I.M., deputy chairman and managing director; Dr. G. A. V. Sowter, Ph.D., B.Sc.(Eng), M.I.E.E., commercial director; Dr. H. H. Scholefield, Ph.D., F.Inst.P., F.I.M., technical director; Mr. D. Norman-Thomas, T.D., F.C.A.; Mr. L. D. Dodd will be secretary.

In addition to operating the factory at Crawley, Telcon Metals Ltd. will control the following subsidiary companies: Magnetic and Electrical Alloys Ltd., Burnbank, Hamilton, Lanarkshire; Telcon-Magnetic Cores Ltd., Chapelhall, Lanarkshire; Temco Ltd., Lydbrook, Glos.; Toolpro Ltd., Ilford, Essex.

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Dr. R. L. P. Berry, beryllium project manager since 1958, has been appointed to the board of **ICI Metals Division.**

Joining the research department of the division in 1936, Dr. Berry spent the war years in the Royal Engineers and the next five at Birmingham University, where he graduated and later carried out post-graduate work on behalf of ICI in the School of Metallurgy.

Since he resumed full-time service with ICI Metals Division in 1951, Dr. Berry has been primarily concerned with the development of "new" metals, notably titanium and beryllium. In 1958 he was appointed project manager in charge of the construction and commissioning of the ICI beryllium plant, which came into operation towards the end of 1959.

Dr. Berry, who is 41, has also been appointed to the delegate boards of two ICI subsidiary companies, Marston Excelsior Ltd. and Lightning Fasteners Ltd.

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Mr. J. R. Cotterill has been appointed manager of the outside services department at the Witton Works of **The General Electric Co. Ltd.** This is a new department formed to co-ordinate erection, commissioning, and post-commissioning service of electrical plant.

Mr. Cotterill is a Justice of the Peace and a member of the Institutions of Electrical, and Mechanical Engineers; the Institute of Marine Engineers; and of the American Institute of Electrical Engineers.

* * *

Sir William Black and Mr. T. A. E. Layborn have been appointed directors of **Standard Industrial Group Ltd.** Sir William is managing director of Park Royal Vehicles and a director of Associated Commercial Vehicles and Birfield Industries. Mr. Layborn is deputy-chairman of C. T. Bowring and Layborn and a director of British Motor Corporation.

Standard Industrial Group includes The Crittall-Aquafont Group of catering equipment manufacturers, Seton Creaghe Engineering Ltd., and Moon Brothers Ltd., manufacturers of drum-making machinery.

Books for Your Library

Métallurgie de la Soudure, by D. Séférian, 1959. Dunod, Paris, 6. 412 pp. (in French). Price 5,800 F.

THIS book is a notable addition to welding literature, written as it is by the late D. Séférian, a man who had great personal knowledge of welding metallurgy and had himself made a substantial contribution to our knowledge of the subject. The title is, however, a little misleading since the contents are devoted exclusively to the welding of ferrous materials. The book is in two parts ; the first being concerned with the metallurgical factors which influence the behaviour of a metal during welding.

After briefly reviewing the different welding techniques in use, the author goes on to consider the metallurgy of iron and steels in terms of the equilibrium diagram and isothermal and anisothermal transformation diagrams. This leads to a consideration of the range of structures actually produced across a weld. In a chapter on electrodes, he considers the role of the coating both as it affects the deposition of the metal and as it affects the composition of the slag formed from it and the slag/metal equilibrium and pseudo-equilibrium. Gas absorption during welding is next considered and the effects of gases on the mechanical properties. The different types of cracking and fissuring are reviewed and the factors governing their cause and prevention.

The second part of the book begins with a review of welding tests, after which the weldability of carbon steels, austenitic steels, low-alloy steels and chrome-molybdenum steels is considered.

The style throughout the book is exemplary, the various problems are considered clearly, critically, concisely and with authority. There are many illustrations of micrographs, photographs and diagrams, while a considerable amount of data is given in tabular form. At the end of each chapter there is a bibliography of what the author considers to be the most significant work on the subject. The author has tried to demonstrate the direct link between the metallurgy of materials and the actual welding behaviour and has succeeded admirably. The result is a book which will be of equal value to the practical welder interested in the metallurgical reasons underlying the choice of welding procedures and to the metallurgist interested in applying his knowledge to welding problems.

R. G. BAKER.

Kempe's Engineers' Year Book, 65th Edition. London, 1960. Morgan Bros. Ltd., 28, Essex Street, London, W.C.2. 2 Vols. Price 87s. 6d.

THIS year's edition of this book of reference is in keeping with the high standard set by previous issues. The book now runs to 84 chapters, covering practically every branch of engineering. A comprehensive index of more than 17,000 entries, and an up to date bibliography at the end of each chapter giving a list of standard works on the subject, make this two volume publication an unequalled time-saving source of reference. Each year every chapter receives the close attention of an eminent authority, thus ensuring that the contents are kept up to date, a vital requirement at present in view of the rapid developments which are taking place in the various fields of engineering. As a result several chapters have been rewritten and more than 120 pages of new tables and text have been added. Among the rewritten chapters are : Electronic Engineering ; Nuclear Power ; Prestressed Concrete ; Diesel Locomotives and Railcars ; Railway Brakes and Signalling, and Naval Architecture. Additions of particular interest to metal workers include sections on cutting tool lubricants, tube bending and fatigue testing machines and the use of steel and alloys at elevated temperatures.

OBITUARY

Boddy : The death is announced of Mr. John Boddy, chief engineer and technical manager of Trico-Folberth Ltd., after a short illness.

It was in 1941 that Mr. Boddy joined Trico as a works manager and he was appointed chief engineer and technical manager in 1946.

Mr. Boddy, who was 55, is survived by his widow, son and daughter.

Ramsell : The death occurred in Wolverhampton recently of Mr. Harold Gilbert Ramsell, at the age of 61, after illness following a major operation last November.

Mr. Ramsell had spent his whole life in Wolverhampton, and on March 1, 1919, he joined H. and T. Vaughan, beginning work in their tool room. Soon after, The Yale and Towne Manufacturing Co. took over H. and T. Vaughan. Mr. Ramsell became works manager, general works manager in the early 40's and general manager upon the retirement of the late J. R. Wilder in April, 1954.

When the company acquired the Willenhall lock firm of E. Tonks and Sons Ltd., Mr. Ramsell was appointed managing director.

A member of the Institution of Production Engineers and the Institution of Mechanical Engineers, he lectured frequently at the Wolverhampton and Staffordshire Technical College, on production engineering and also lectured all over the country on the manufacture and design of locks.

Wood : Mr. George Wood, C.B.E., vice-president of Thos. W. Ward Ltd., Albion Works, Sheffield, died in Sheffield on March 14, 1960, after a long illness.

He joined Thos. W. Ward as a boy in 1897, when the offices were in Fitzalan Chambers, and was appointed local director in 1919. In the succeeding years he played a considerable part in building up the company and its subsidiaries to its present size and importance. He was made a director in 1923 and assistant managing director in 1928. In 1941 he became joint managing director and deputy chairman, and in 1950 was appointed chairman. In 1954 he felt the need to take a less active part in the management of Thos. W. Ward Ltd., and relinquished the office of chairman to become vice-president.

An acknowledged expert on iron and steel scrap and shipbreaking, Mr. Wood was director of scrap iron and steel supplies to the Iron and Steel Control in the early years of World War II and also of British Iron and Steel Corporation (Salvage) Ltd., which was responsible for salvaging of marine scrap during the war. He was a past-president of the Yorkshire Scrap Iron, Steel and Metals Association and a past vice-president of the British Shipbreakers Association.

In 1951 Birthday Honours he was awarded the C.B.E., a fitting reward for many years' service to country and industry.

During his 57 years of active participation in the affairs of the Ward group Mr. Wood was chairman or managing director of several subsidiary companies but had relinquished most of these appointments in the last few years.

Mr. Wood leaves a widow and a son, Mr. G. Stuart Wood, who is also a director of Thos. W. Ward Ltd. and other firms in the group.

Publications for Industry

The film has for some time been a medium through which countless students and apprentices have received valuable instruction. The Carborundum Film Unit, an active contributor of this product since 1920, has issued a booklet describing some of their more recent work. Among films showing the role played by abrasives in present day engineering, there appears what is probably the only film on the subject of industrial heat control. The expert and student of furnace and foundry technology should find this film both instructive and of absorbing interest. " In the Hot Zone " is a 16-mm. film in colour and runs for 27 minutes. Further information may be obtained from The Carborundum Co. Ltd., Trafford Park, Manchester, 17.

* * *

For some years Johnson Matthey and Co. Ltd., have produced the rare earths and recent research into the application of ion-exchange techniques to the separation of these materials has made them available in large quantities, in various grades of purity, and at much lower cost than hitherto.

New techniques have also been applied to the production of the rare earth metals and all the 14 " lanthanons " that occur naturally and the related elements scandium and yttrium are now available in a state of high purity.

All of the 16 metals have been remelted into ingots or rods and have been successfully extruded, and subsequently drawn to fine wire.

A publication, " Products of the Rare Earth Group," just issued by the company, describes the properties, characteristics and availability of this potentially valuable and very topical range of materials. This is available free on request to the company's head office at 73-83, Hatton Garden, London, E.C.1.

* * *

The new F.B.I. booklet " European Free Trade Association," gives a brief historical background leading up to the signing of the Outer Seven Convention and provides a commentary on the terms of the Convention itself.

The booklet sets out objects of the Convention then deals with the sections of the Convention covering import duties, import quotas, definition of origin and deflection of trade, and the escape clauses included to safeguard members of the Outer Seven in the event of any deterioration in their balance of payments or difficulties experienced in any particular sector of industry. Appendices give the basic materials list, details of the special provision in the Convention for Portugal and a series of charts giving vital economic data on each of the member countries at a glance. The booklet may be obtained from the F.B.I., 21, Tothill Street, London, S.W.1.

* * *

Inco-Mond Magazine No. 12 recently published, features important applications of the austenitic nickel-containing stainless steels in many and varied industrial and the domestic fields.

Architectural metal work, catering and food-processing plant are made from nickel-containing stainless steels because of their fabricating and corrosion qualities and articles in this issue of the magazine illustrate typical applications.

Inco-Mond magazine is obtainable free on request from The Mond Nickel Co. Ltd., Publicity Department, Thames House, Millbank, London, S.W.1.

* * *

Maximum production, a desirable feature of any industry, and obtainable in cold strip rolling processes by accurately assessing short slow-down times, has been greatly enhanced by the development of two types of automatic slow-down equipment, manufactured by the English Electric Co. Ltd., Metal Industries Division, Stafford. In their recent publication, " Automatic slow-down control for reversing cold strip rolling mills," both types are described. Type 1, a mechanical device working on the roller rheostat system, is capable of executing the slow-down in three or four stages and tests indicate a long-life expectation for little attention. Type 2, electronically operated, employing a 4-stage Dekatron counter, contained in two Dekatron chassis and a standard supply chassis, can be connected to a 230-volt single-phase 50-cycle supply, taking not more than 2 amps. Both types require suitable connections to be made available in the mill-control system and have similar interlocking contacts. Additional data is available from the manufacturers on request.

* * *

" We live at a time when more and more people tend to know less and less about what other people are doing, even though the things being done touch our lives at every turn." These words introduce a book recently published by S. Smith and Sons (England) Ltd., Cricklewood, London, N.W.2, entitled " The World of Meaning." It attempts to cover the panorama of the great organization of Smiths, and to convey a far ranging impression of the significance of the work completed and the work still in progress within the firm. The book is divided into three sections; the first, surveys the principal fields of activity and aspirations to which the company's knowledge, ideas and specialized workmanship are making an increasing contribution. The second shows how research and technological training are provided for the future and the final section is devoted to a summary of all items the company makes. The survey is written and illustrated in a very attractive manner and will appeal to the reader both as a story and as a source of reference. It is obtainable from the publishers at the above address.

* * *

Titanium resists attack by a very wide range of aggressive media and in many environments is superior to stainless steel. Its use in chemical engineering has opened the way to great improvements in efficiency of existing plant and in design of new equipment and chemical engineers are finding the advantages offered by titanium more than justify its higher initial cost. The development of titanium and its alloys is backed by the technical resources of I.C.I. Metals Division, and in a recently issued booklet, " Corrosion Resistance," the third of a new series of publications on wrought titanium, they cover the properties, corrosion-resistance, and fabrication, with some general observations indicating the environments in which the advantages of titanium are most insignificant. The booklet is available on request from Imperial Chemical Industries Ltd., Metals Division, P.O. Box 216, Birmingham, 6.

* * *

The Pye Applications Department has been established to help customers who require advice on the suitability or choice of an instrument for a particular application. The department is compiling a comprehensive reference library and part of the service they wish to give includes the issue from time to time of Application Sheets relating to many and varied uses of the companies instruments. Many of the sheets already compiled concern instruments relative to the metal-finishing industry, and are available free of charge on request from W. G. Pye Co. Ltd., Granta Works, Cambridge.

Forthcoming Events . . .

May 2

Society of Chemical Industry (London Section). "The use of Photography in Industry," by Dr. H. Baines, B.Sc., Hon.F.R.P.S., F.R.I.C. The Society's Rooms, 14, Belgrave Square, S.W.1. 6.30 p.m.

May 3-4

The Institute of Metals. Joint meeting on the "Determination of Gases in Metals," organized by the Society for Analytical Chemistry in conjunction with the Iron and Steel Institute and the Institute of Metals at the Church House, Great Smith Street, London, S.W.1.

May 4

The Institution of Plant Engineers (Southern Branch). "Insulation of Buildings," by J. Churton, A.R.I.B.A., Department of Scientific and Industrial Research, at the Polygon Hotel, Southampton. 7.30 p.m.

Institute of Sheet Metal Engineering. Annual General Meeting, at Cafe Royal, Regent Street, London, W.1. 12 noon.

May 4-6

The Institution of Plant Engineers. Annual Conference at the Grand Hotel, Scarborough.

The Institution of Chemical Engineers. Joint meeting with the Chemical Engineering Group, The Society of Chemical Industry, sponsored by The European Federation of Chemical Engineering, at the Dome, Brighton. "International symposium on distillation."

May 5

The Institute of Metal Finishing (North-West Branch). Annual General Meeting and Platers' Forum at the Engineers' Club, Albert Square, Manchester. 7.30 p.m.

May 6

The Institute of Metal Finishing (Sheffield and N.E. Branch). "Performance of Metallic and Organic Finishes for Motor Vehicles." by R. J. Brown, at the Grand Hotel, Sheffield. 7 p.m.

The Institution of Production Engineers (North-Western Region). Regional dinner. Midland Hotel, Manchester. 7.15 p.m.

May 9-11

The Institute of Welding. Spring meeting, Droitwich.

May 10

The Institution of Plant Engineers (Manchester Branch). "The Application of New Materials to Plant Engineering," by J. Leyland, M.Sc., M.I.Mech.E., A.M.I.Chem.E., Head of the Engineering Section, Central Research Department, Unilever Ltd., at the Engineers' Club, Albert Square, Manchester. 7.15 p.m.

May 12

The Institution of Plant Engineers (North-East Branch). "Science and Industry," by E. Martindale, Department of Scientific and Industrial Research, Edinburgh, at Roadway House, Oxford St., Newcastle-upon-Tyne. 7 p.m.

May 16

The Institute of Metal Finishing (London Branch). "The Properties of Thin Chromium Deposits," by D. E. Weimer, at the Northampton Polytechnic, St. John Street, London, E.C.1. 6.15 p.m.

May 18

The Institute of Metal Finishing (South-West Branch). "Phosphating," by D. M. Regan, at the Royal Hotel, Bristol. 6.30 p.m.

The Institution of Plant Engineers (London Branch). "Factory safety," by a member of H.M. Factory Inspectorate, at the Royal Society of Arts, John Adam Street, London, W.C.2. 6.30 p.m.

The Institute of Vitreous Enamellers (Southern Section). Works visit to Watson House.

May 19

The Institute of Vitreous Enamellers (Northern Section). Annual General Meeting and Social at the Old Nag's Head, Jackson's Row, Manchester. 7.30 p.m.

May 23-25

The Institute of Sheet Metal Engineering. "Colloquium on the Shaping and Testing of Metal Sheet." Joint meeting in Paris of the International Deep Drawing Research Group and the Société Française de Métallurgie.

May 24

The Institution of Plant Engineers (South Wales Branch). "Controlled Maintenance," by G. E. Halter, M.Inst.Pet., at the South Wales Engineers' Institute, Park Place, Cardiff. 7.30 p.m.

Newport and District Metallurgical Society. Summer visit to English Electric Company's works at Stafford.

"WORK OF ENGINEERING CONSTRUCTION"

Definition to be Widened

REGULATIONS extending the definition of the expression "work of engineering construction" in Section 152 of the Factories Act, 1937, were recently laid before Parliament by Mr. Edward Heath, Minister of Labour, and will come into operation on May 15, 1960.

Under these regulations works which now will be also included within the definition are the construction, structural alteration or repair (including re-pointing or re-painting), or the demolition of any steel or reinforced concrete structure other than a building, any road, airfield, sea defence works or river works, and any other civil or constructional engineering works of a similar nature to any of these works.

The definition will not, however, apply to these works if they are carried on in a factory as defined in the 1937 Act, or on premises to which that Act applies, or on a railway or tramway.

The effect of the regulations is that from May 15 next the requirements of the Factories Acts about sanitary conveniences, and notifying sites of operations, accidents and industrial diseases among others will apply to these classes of work. The new safety regulations for construction work which the Minister proposes to make will also apply to them.

HADFIELD BRONZE MEDAL

DR. J. C. HUDSON, Head of BISRA's Corrosion Section, has been awarded the Sir Robert Hadfield bronze medal by the Iron and Steel Institute. This annual award, instituted in 1947, is a recognition of distinguished service in the development of the science of ferrous metallurgy.

This is the second major award bestowed on Dr. Hudson within six months. In November last the American National Association of Corrosion Engineers gave him their Frank Newman Speller Award for 1959.

Change of Telephone Number

The Incandescent Heat Co. Ltd. announce that the London Office telephone number has been changed from Sloane 7803 to Belgravia 7803-5. The London Office has been recently enlarged to accommodate the rapidly increasing amount of business transacted there for members of the Incandescent Group, but the address, 16, Grosvenor Place, London, S.W.1, remains unaltered.

New Plant and Equipment

Contour Shear

THE Wales-Strippit Corporation in the United States has recently developed a new type of shearing machine, called "Tru-Edge Contour Shear," for circle and shape cutting, beading and forming. While the conventional type of nibbler removes slugs of metal as it proceeds along a scribed line and is apt to leave a scalloped edge, this new machine, it is claimed, does not remove metal but simply shears one part of the metal against the other, leaving a completely smooth burr-free edge, which will not require any finishing operation.

The machine, which is illustrated in Fig. 1, consists of an upper cutting tool operated by a motor to give an upwards and downwards cutting stroke, and a lower cutting tool fixed in an anvil block. When properly adjusted to suit the thickness and texture of the metal being cut, these two tools give the combined effect of cutting and shearing and the resultant burr-free edge.

Only three adjustments are necessary to ensure a perfect cut, viz. :—

(1) Length of stroke ;

(2) Horizontal space between the faces of the lower and upper cutting tools ;

(3) Vertical adjustment of the lower tool in relation to the upper.

In general, the shortest stroke possible gives the best cut but softer metals such as lead, copper or aluminium require a longer stroke than the harder metals such as mild steel because soft metals do not make a clean shearing break.

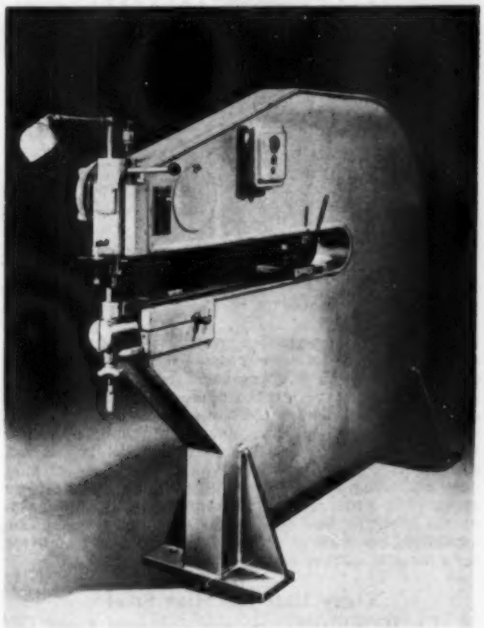


Fig. 1.— Contour shear

Swivel Face Shield

PYRENE PANORAMA LTD., Windmill Road, Brentford, Middlesex, have designed a new face shield, F.V.8 which is claimed to have a greater degree of ventilation, thereby improving its de-misting properties.

An aluminium strip, swivel mounted on a screw adjustable head harness, carries a heat reflecting or clear or coloured acetate "Celastoid" screen which can be supplied in 6 in., 8 in., 10 in. and 12 in. depths. The screen is readily removable, being held in position by non-ferrous set screws and plastic-covered nuts which are secure when hand tight.

Dusting Tool

ANTI-DUST SERVICES LTD., 53a, Stafford Street, Dudley, Worcs., have introduced a long reach taccy dusting broom with a 15-in. wiping width backed by resilient foam that conforms to surface irregularities, mouldings or skirtings and which provides a sufficient even pressure to take off all dust, fluff and grit in a single wipe with no dust disturbance. The dirt is enveloped by the taccy impregnation of the coverings which can continue to collect dust until increasing dirt and grittiness renders them unfit for further use, when they can be discarded. Spare taccy coverings are available in packets of one dozen, and embody an impregnation which is neutral in constituents and harmless to all surfaces.

Technique for Marking Angles, Channels and Bars

FIG. 2 shows a roll marking machine produced by Edward Pryor and Son Ltd., of Broom Street, Sheffield, for the marking of trade marks on black angle, channel and bar materials at intervals. The machine has been designed to overcome the difficulties involved in procuring impressions deep enough to be filled with a paint contrasting with the normal painted colour of a long part.

In general practice, if heavy impressions are made in a press with a flat die, "drag down" of material occurs inside closed characters and in narrow spaces between adjoining characteristics and as full depth of impression is not obtained, paint filling is rendered difficult ; in addition, commercially rolled angle and channel materials often have variations in thickness which are large relative to the depth of impression which can be produced, and unless the machine can accommodate these variations distortion of material and dissimilarity in depths of impressions will occur.

In the Model E.P. 49 marking machine roller dies are used moving progressively over the material with multiple passes of the die made at moderate pressure so that the impression is gently "kneaded in." The load on the die is air-controlled and the multiple passes are controlled by an electrically-operated counting device, the number of passes being pre-determined and preset on the instrument panel.

For normal operation on long pieces of material, the machine is automatic and the sequence of marking operations controlled by a number of micro-switches

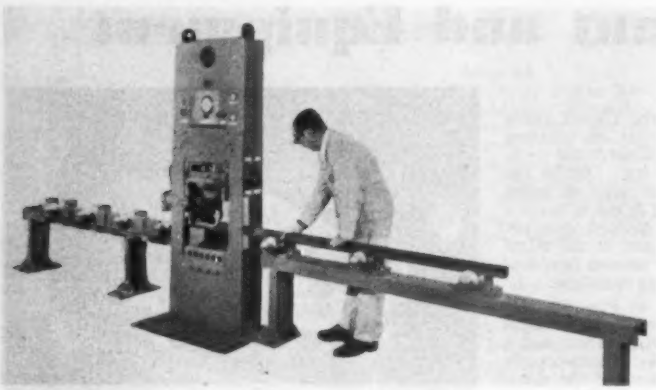


Fig. 2.—Marking machine for angles, channels and bars

arranged in the out-going conveyor which energize the machine when the material passes over them. For short pieces of material, a changeover switch on the small instrument panel cuts out the micro-switches of the out-going conveyor and alters the circuit for individual manual control cycling. The machine in the illustration has been constructed to deal with 8-ft. lengths of material and for impressions at intervals of 18 in. when working on the automatic cycle; these dimensions may be altered appreciably without any significant change in the design of the machine and the rollers on the conveyors are capable of assembly in different combinations to provide for a range of sizes of material.

X-ray Unit for Mild Steel

A LIGHTWEIGHT, portable industrial X-ray unit of 300 kV. capacity, known as the Baltospot G300D has been introduced by Pantak Ltd., of Vale Road, Windsor, Berks, for examination of mild steel of up to 3 in. in thickness (Fig. 3).

The insulation and cooling of the X-ray tube in this unit is effected by a chemically and physiologically inert and non-inflammable gas, which results in a lightweight tank head construction and achieves a high power/weight ratio. The weight is 142 lb. The unit can be supplied with either a conventional 40-deg. solid angle beam insert tube with a fine focus, size 3.0 mm., or a 360-deg. circumferential radiation insert tube. Cooling of the anode is achieved in either case by forced circulation of the insulating gas by means of an internal blower.

The tank head, which is cylindrical in shape, is pressurized and is fitted with a pressure gauge so that the insulating gas may be checked at any time. A cradle is supplied with anti-shock mountings. The tube is protected against excessive temperature by a thermo-switch mounted in the tank head. A further device in the control unit simulates the thermal capacity of the anode and gives the operator a visual indication of overheating. A particular advantage is that a series of exposures can be planned without risk of overheating the tube. The maximum dimensions are 40 in. long by 9 in. diameter. When fitted with the protective cradle the weight is increased from 142 lb. to 171 lb. The control unit is of the carrying case type, the maximum dimensions being 18 in. long by 14 in. wide by 8 in. deep. The weight is 60 lb.

The control operates from a 220-volt, 50-cycle single-phase supply and accommodates fluctuations of 10 per cent either way. It is fitted with direct-reading kilovolt and milliameters in addition to a synchronous timer which can be arranged for automatic repetition of exposures. The kilo-voltage and tube current controls are of the stepless type giving continuously variable control.

Among the accessories supplied as standard are a telescopic centre finder (fold-back type), end rings for tank head, protective cradle for tank head, 30-ft. mains cable and 2 by 30-ft. control-to-head cables which can be connected together, thus making a 60-ft. cable if required.

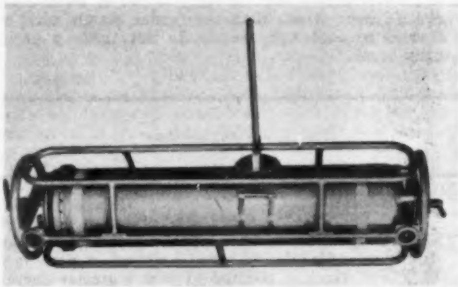


Fig. 3.—X-ray unit for mild steel

Multi-riveting Machine

A NEW development by Rhoden Partners Ltd., 19, Fitzroy Square, London, W.1, is an air-operated, double-acting press especially designed for riveting semi-tubular rivets (Fig. 4). Unlike conventional riveting machines that punch one rivet at a time, this machine automatically feeds and punches several rivets at a time. Feeding and then punching a whole pattern of rivets simultaneously results not only in speedier operation but the quality of the finished work is improved because components do not become distorted as is so often the case when rivets are punched one after the other. A further advantage of this air-operated equipment is that the squeezing action of the punches is less violent than the impact punching in mechanical riveting machines.

The operating cycle is as follows:—

1. The operator loads the components to be riveted together on to the spring-loaded location pins in the bottom bolster.

(*Continued in page* 392)

2. The operator depresses the push buttons which initiate the automatic sequence of operations 3—6. (As a safety device dual push buttons, remote from the tool area, are provided to ensure that the operator's hands will be in safe positions while the rams descend.)

3. The work-holder ram descends and clamps the components together.

4. The number of rivets required for an assembly is delivered to the components and inserted into the rivet holes.

5. The punches descend and form over the rivets.

6. The work-holder ram and the punch rams rise together.

7. The operator removes the riveted assembly.

The automatic sequence of operations 3—6 takes approximately three seconds, the total operating cycle time depends also on the number of components in the assembly and the efficiency of the operator.

A single-phase (230-250 v.) electrical supply (for the "Syntron" vibratory bowl feeder) and a compressed-air supply (preferably 80 lb. per sq. in.) are required.

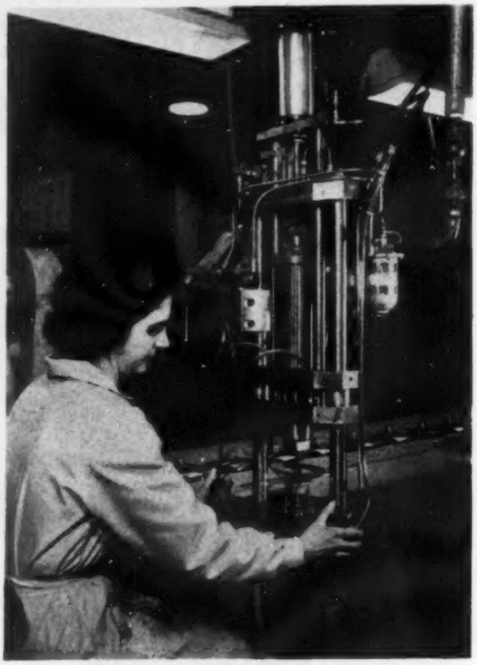


Fig. 4.—This riveting machine automatically feeds and punches several rivets simultaneously

Automatic Units for Tungsten-Inert Gas Welding

AIRCO COMPANY INTERNATIONAL, a division of Air Reduction Company, Inc., in the United States, has recently developed two entirely new designs of Heliweld automatic units, designated as models HMH-D and HMH-E, for use with tungsten-inert-gas welding processes.

The new units are electronically controlled and can be used for either a.c. or d.c. Heliwelding, without an accessory control, using argon, helium or mixtures of these shielding gases as required. They are specifically designed for long-run production applications on all ferrous and non-ferrous metals where good weld appearance is necessary or where stringent specifications must be met.

They are identical with one exception, the model HMH-D is equipped with 3-in. offset bars to which the machine holder can be attached. Principal advantages of the machines are sensitivity and response to changes in arc length; touch or high frequency starts; 360-deg. rotation in any position with a 2-in. adjustment of the machine holder across the weld bead; and vertical travel distance of 14½ in.

The new automatic units can be operated at a maximum of 500 amp. continuous duty cycle d.c. straight polarity using thoriated tungsten electrodes, or 350 amp. a.c. electrode diameters from 0.010 in. to $\frac{1}{16}$ in. may be used. Holders have a maximum vertical rate of rise of 24 in. per min.

Portable Hand Embosser

THE British Automatic Company have introduced a portable hand embosser called the "Midgie" (Fig. 5) which embosses letters and numbers on hard wearing, corrosive and chemical resisting Vinyl red plastic tape which has a pressure-sensitive adhesive backing for instant and easy application to most smooth and clean surfaces.

The equipment is 10½ in. long and is precision made. The plastic labelling is self feeding and all that is required is to dial the letter or number and squeeze the handle.

Because it is portable, the machine is ideal for dials, controls and gauges of all kinds; for labelling raw materials and parts stored in outdoor areas; for making durable labels for panel boards; permanently embossed labels for chemicals, tools, wiring, electrical parts, instruments, etc.

The plastic labels are waterproof and embossed with permanently raised letters $\frac{5}{32}$ in. type size. The tape is ½ in. wide by 12 ft. long. The "Midgie" is available from the British Automatic Company, 14 Appold Street, London, E.C.2.

(*Continued in page* 394)

Fig. 5.—Portable hand embosser

Press Clutch Valve

J. P. UDAL LTD., I.G.E. Automotion Division, Court Road, Birmingham, have introduced a new press clutch valve which it is claimed provides complete " fail to safe " features for any electro-pneumatic system.

The I.G.E. patent " Saffail " valve as it is called is designed so that there is five times the force available to move the operating spool from " On " to " Off " than there is available to move it from " Off " to " On." This differential is checked electrically every operation, and when the differential drops through any fault, the valve is locked " Off " until the fault is rectified.

A control system has been designed around this valve for electro-pneumatic power-press clutches which gives complete self-checking of all electrical circuits and provides a safeguard against uncovenanted or repeat strokes of the press.

The valve, which is illustrated in Fig. 6, is manufactured by TAL Numatics, whose own special spool construction is incorporated.

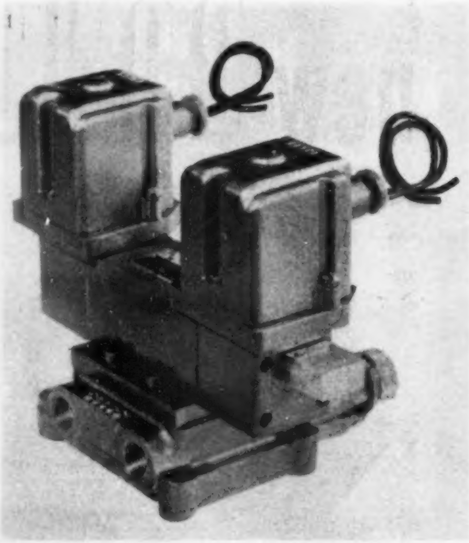


Fig. 6.—Press clutch valve

Spark Erosion Machine

WICKMAN LTD., Banner Lane, Tile Hill, Coventry, have produced a new machine (Fig. 7) in their Erodomatic range specially designed for the semi-automatic production and servicing of dies up to a maximum size of 28 in. by 16 in. by 15 in. deep. The inherent self-feeding characteristics of the spark-machining process have been employed to produce the machine, which, once set-up, will continue erosion throughout any die-sinking operation completely unattended, and thus reduce the labour content to very small proportions.

The equipment is designed as three units ; the machine tool, generator, and dielectric fluid circulator, each being capable of disposition according to the shop layout. The units are of uniform width and particularly suitable for in-line arrangement.

With the exception of a cartridge-fused main isolating switch mounted in the rear of the electrical unit and the water stop cock, operating controls are brought to a sloping panel on to the front of the machine. The work-tank is provided with a float switch controlling the generator and servo-control system. This ensures that cutting power cannot be delivered to the electrode until the workpiece is properly immersed in dielectric fluid and thus removes the risk of fire or danger to the operator from electric shock.

Three cutting ranges are incorporated, selected by a lever switch and alternative generators of different maximum power rating are offered, *i.e.*, 13 kW. and 4.5 kW., which increase the cutting range but do not impair surface finish.

Brief particulars of the machine with alternative generators, are as follows :—

13 kW.

Range 1 : Controlled frequency 600 cycles per sec. Maximum metal removal rate—1,000 cu. mm. per min. Loading 12 kW.

Range 2 : Controlled frequency 600 cycles per sec. Maximum metal removal rate—300 cu. mm. per min. Loading 4 kW.

Range 3 : Random frequency. Maximum metal removal rate—100 cu. mm. per min.

4.5 kW.

Range 1 : Controlled frequency 100 cycles per sec. Maximum metal removal rate—400 cu. mm. per min. Loading 4.5 kW.

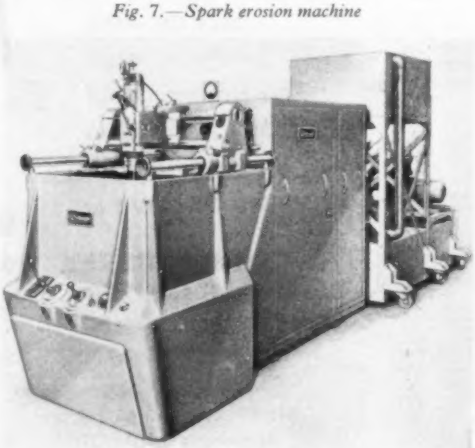
Range 2 : Random frequency. Maximum metal removal rate—150 cu. mm. per min. Loading 3 kW.

Range 3 : Random frequency. Maximum metal removal rate—100 cu. mm. per min. Loading 2 kW.

Electrical supply is at 400/440 volts, 3 phase, 50 cycles.

(*Continued in page* 396)

Fig. 7.—Spark erosion machine



The contacts are silver-plated copper and the busbars and main connexions are of electro-tinned copper. All ferrous components are treated with phosphate rust deterrent and are painted, the standard overall finish being medium hammer grey.

Drill Sharpening Machine Giving a New Drill Shape

THE Cincinnati Lathe and Tool Co., Cincinnati 9, Ohio, U.S.A., have developed a drill sharpening machine which quickly and simply gives a standard twist drill a new surface shape, *viz.*, a spiral point. The effect of this new spiral point drill is said to eliminate the preliminary and secondary operations such as centre punching, guide bushing, reaming, boring, etc., and enables closer tolerances to be maintained. It is also claimed to give greater hole roundness and straightness, reduce thrust requirements for operating and prolong drill life. The new machine is illustrated by Fig. 8 and Fig. 9 shows close-ups of a drill that has been given a spiral point.

Throughout the drilling operation the drill continues to centre itself, giving a clean, round, accurate straight hole, which is practically burr-free. The better cutting angles at the point of the drill produce a shearing effect into the metal and the resultant chips escape readily into the flute because of the more acute angle presented by the spiral point to the axis of the drill than is offered by the normal chisel point drill, which tends to extrude the metal and the resultant chips are apt to become trapped between the face of the drill point and the bottom of the hole, thus not only creating heat but increasing the clearance at the outside diameter of the drill, where the least clearance is needed. The reduction in heat generation afforded by the spiral point drill prolongs its life and also reduces the frequency of sharpening and consequent idle time for drill changing. In addition, the superior cutting action of the drill reduces thrust requirements in some cases by as much as 34 per cent.

The spiral point drill has been found particularly useful for sheet-metal drilling carried out by hand when the operator finds it most difficult to control the initial tendency to walk, and where there is also a tendency on the part of the drill to "grab" metal, creating a large amount of burr and a hole which is badly out of round. The point angle recommended for sheet metal is 180-deg. instead of the usual 118-deg.

The "Spiropoint" is simple to operate since all that is required of the operator is to place the drill into position and set the dials for size and angle, the rest of the operation being automatic.

The machine is shipped as a complete unit ready to run. All electrical equipment, tools, grinding wheels and operating instructions are included as standard equipment. The machine is mounted on castors, is equipped with screw jacks for levelling on uneven floors and contains an individually motor driven dust collector.

Charles Churchill and Co. Ltd., of Coventry Road, South Yardley, Birmingham, are the selling agents in the United Kingdom for this and other Cincinnati machines.

Fig. 8 (above).—Drill sharpening machine

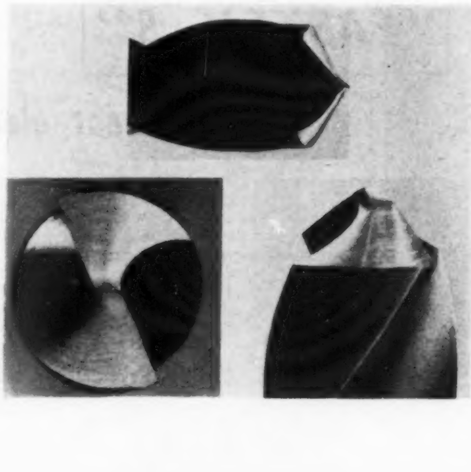


Fig. 9.—Three views of a drill sharpened in a Spiropoint machine

Electrical Aids in Industry *Data Sheet* **No. 11**

Dielectric Heating-2

The ability of dielectric heating to generate heat through the mass of a suitable material provides the following considerable advantages over other heating methods.

1. A body of uniform section and composition is heated uniformly throughout. Hence there is no waiting for heat to be conducted to the centre of the body, and this is of particular advantage when the body is thick, and, as is often the case with dielectric materials, has poor heat-conducting properties.

2. The rate of heating can be faster than by external heating methods.

3. Since there is no external heat source, overheating or burning of the surface of a heat-sensitive material is avoided.

4. Heat input and heating time can be positively controlled.

5. High thermal efficiency is achieved.

6. Production can start immediately after switching on, and no current is used, nor heat lost, during periods of shut-down.

7. Vastly increased productivity is obtainable with less labour (usually unskilled), and fewer machines and less floor space are required.

8. Dielectric heating provides flexibility of layout and can be inserted directly in the production line.

Dielectric Heating: typical application data

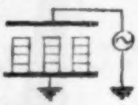
Typical application	Frequency	Radio frequency power
Thermoplastic welding.	20-100 Mc.p.s.	Up to 1 kW
Plastic preheating, wood glueing.	10-40 Mc.p.s.	2-30 kW
Plywood manufacture.	2-10 Mc.p.s.	Above 30 kW

Note: 1 Mc.p.s. = 1,000,000 cycles per second.

A few of the industrial applications of dielectric heating are briefly described below.

Preheating Thermosetting Plastics

Dielectric heating is ideal for preheating pellets used for thermosetting plastic mouldings, which are poor heat conductors. It promotes faster curing, reduces moulding time and can increase production 10 to 15 times. Tool wear and damage to metal inserts are reduced, and thicker sections can be moulded.



Welding of Thermoplastic Materials

An important and extensive application of dielectric heating is the welding of thermoplastic sheets in the fabrication of such commonly used articles as raincoats, hoods, handbags, pouches and packaging materials. Dielectric heating is the only method which can usefully be employed, since the heating electrodes, and hence the outside sheet surfaces, remain cool while the inside surfaces forming the joint are fused, and a perfect weld results.

Two or more thermoplastic sheets are welded under pressure from electrodes suitably shaped to the area of weld required, the current being switched on at the same time as pressure is applied, and off when the weld is completed and the pressure released. Stitching is thus eliminated and a far stronger joint achieved.

In some cases, a suitably profiled electrode can be fitted with a knife edge to cut the sheets immediately outside the weld line, welding and pattern-cutting being thereby carried out in the one operation. Dielectric welding can be applied also to very large thermoplastic products such as linings for swimming pools, and cinema screens.

Drying

Drying of materials by dielectric heating has the great advantage that the material tends to dry out from the centre, the reverse of what happens when external heating methods are employed, and the risk of overdrying and overheating of the surface is eliminated. While the removal of large amounts of water from inexpensive commodities may sometimes be uneconomical, dielectric heating in the production line often leads to a higher overall production efficiency. It is valuable for removing final moisture traces and becomes increasingly economical as the value of heat-sensitivity of the commodity increases.

For further information get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2. Telephone: TEMple Bar 9434.

Excellent reference books on electricity and productivity (8/6 each, or 9/- post free) are available — "Induction and Dielectric Heating" is an example.

E.D.A. also have available on free loan in the United Kingdom a series of films on the industrial uses of electricity. Ask for a catalogue.

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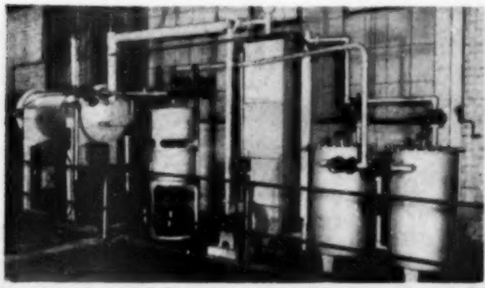
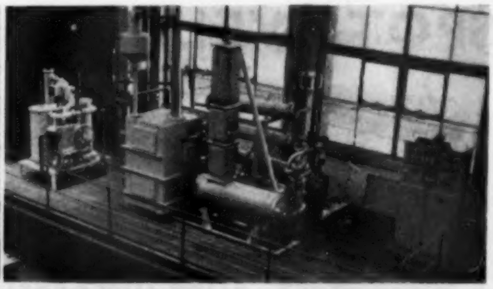
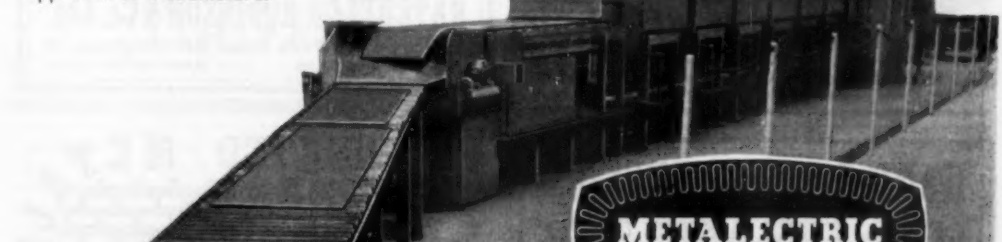
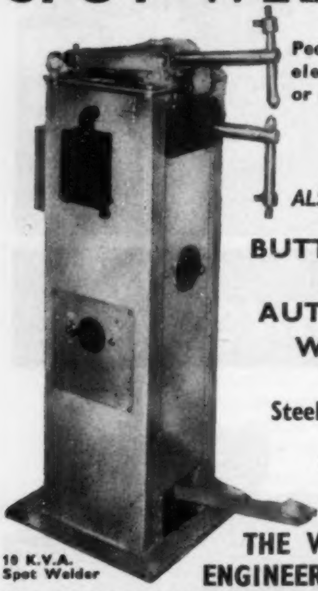






SPOT WELDERS



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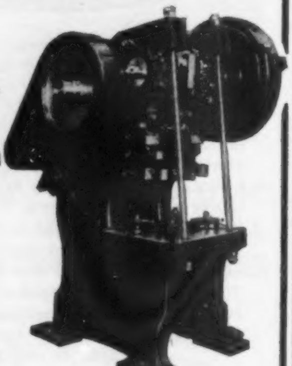

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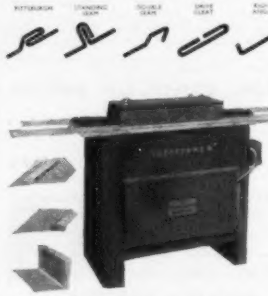

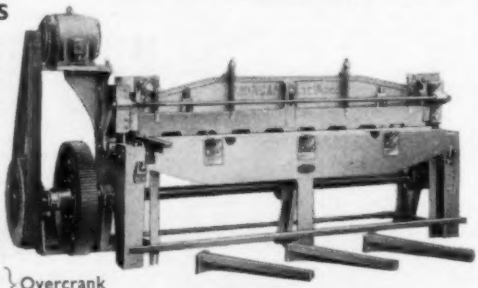

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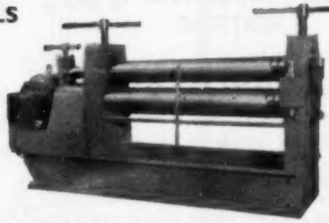

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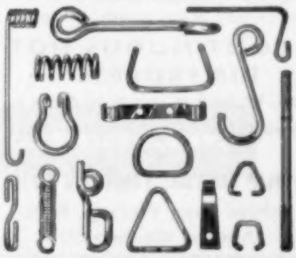

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